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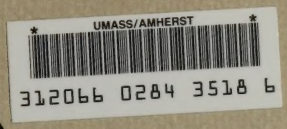

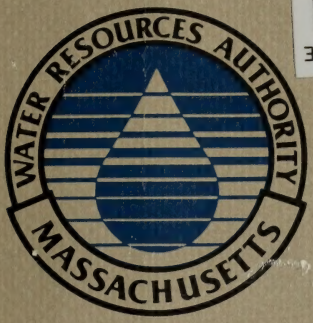

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Secondary Treatment Facilities Plan

Volume VII

Institutional Considerations

DRAFT REPORT

November 13, 1987

Secondary Treatment Facilities Plan

Volume VII

Institutional Considerations

DRAFT REPORT

November 13, 1987

Notice to Reviewers

Attached for your review is Volume VII Institutional Considerations, of the Secondary Treatment Facilities Plan.

To date the MWRA staff and Board of Directors have not reviewed this document but they have been briefed on its contents. No approval will be issued until the public review process is complete. The report is being circulated at this time to seek early review and comment by interested parties. Comments will be presented to the Board of Directors as they continue their review of the draft report.

Information in this report is current as of November 13, 1987.

Daniel K. O'Brien
Acting Director
Engineering Division
November 13, 1987

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How to Use
the
Secondary Treatment Facilities Plan

The Secondary Treatment Facilities Plan is organized into seven volumes.

The major components of the Secondary Treatment Facilities Plan are: Treatment Plant, Inter-Island Transport System, Effluent Outfall, and Early Site Preparation.

The Secondary Treatment Facilities Plan document consists of a stand-alone volume for each of these components as well as volumes for Facilities Planning Background, Institutional Considerations, and Executive Summary.

Each volume may be referenced to find complete planning information pursuant to that project component. The seven volumes are numbered as follows:

Volume I	Executive Summary
Volume II	Facilities Planning Background
Volume III	Treatment Plant
Volume IV	Inter-Island Transport System
Volume V	Effluent Outfall
Volume VI	Early Site Preparation
Volume VII	Institutional Considerations

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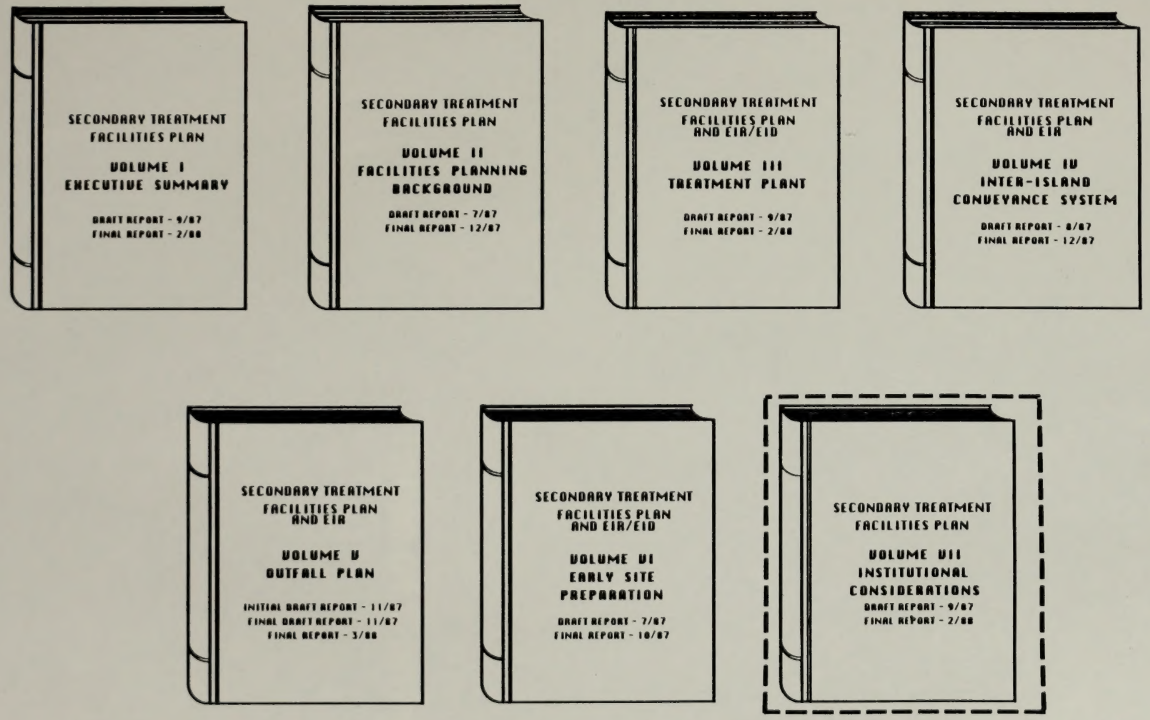
SECONDARY TREATMENT FACILITIES PLAN
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DRAFT REPORT - 9/87
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SECONDARY TREATMENT FACILITIES PLAN AND EIR
VOLUME IV INTER-ISLAND CONVEYANCE SYSTEM
DRAFT REPORT - 8/87
FINAL REPORT - 12/87
SECONDARY TREATMENT FACILITIES PLAN AND EIR
VOLUME V OUTFALL PLAN
INITIAL DRAFT REPORT - 11/87
FINAL DRAFT REPORT - 11/87
FINAL REPORT - 3/88
SECONDARY TREATMENT FACILITIES PLAN AND EIR/EID
VOLUME VI EARLY SITE PREPARATION
DRAFT REPORT - 7/87
FINAL REPORT - 10/87
SECONDARY TREATMENT FACILITIES PLAN
VOLUME VII INSTITUTIONAL CONSIDERATIONS
DRAFT REPORT - 9/87
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DEER ISLAND
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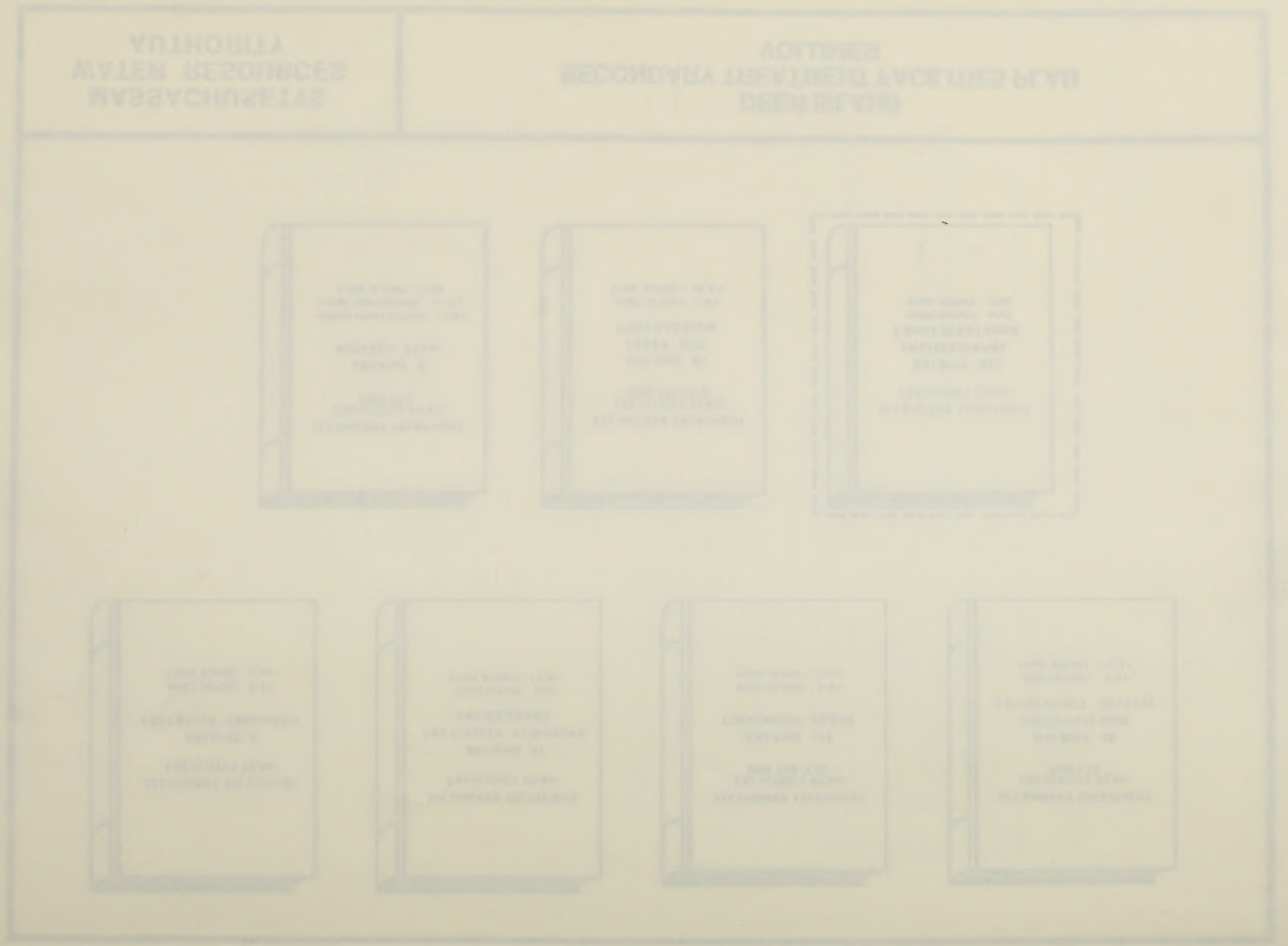

Table of Contents

Secondary Treatment Facilities Plan
Volume VII
Institutional Considerations
Draft Report
November 13, 1987

Title Page
How to Use This Document
Volume Identification
List of Tables
List of Figures

Section			Page
1.0	Summary		1-1
	1.1	Project Identification	1-1
	1.2	Brief Description of Project	1-1
	1.3	Organization of This Report	1-2
	1.4	Major Conclusions	1-2
		1.4.1 Project Schedule	1-2
		1.4.2 Program Management	1-8
		1.4.3 Project Financing	1-9
		1.4.4 Human Resource Needs	1-13
		1.4.5 Require Legislative Regulatory Actions	1-14
		1.4.6 Internal and External Coordination Requirements	1-14
2.0	Introduction		2-1
	2.1	Project Need	2-1
	2.2	Planning Approach	2-3
	2.3	Scope of Work	2-4
3.0	Project Background		3-1
	3.1	Previous Studies	3-1
	3.2	Siting Decision	3-2
		3.2.1 Effect on Neighbors	3-6
		3.2.2 Equitable Distribution of Regional Impacts	3-9
		3.2.3 Cost	3-10
		3.2.4 Implementability	3-11
		3.2.5 Reliability	3-12
		3.2.6 Harbor Enhancement	3-13
		3.2.7 Effect on Natural and Cultural Resources	3-14
		3.2.8 Mitigation Measures	3-15
		3.2.9 Criteria Weighing Process	3-18

	3.2.10	Tentative Selection	3-19
	3.2.11	Final Selection	3-19
3.3	Related Projects		3-49
	3.3.1	Projects	3-49
	3.3.2	Industrial Waste Program	3-50
	3.3.3	Treatment Plant Upgrade Programs	3-53
	3.3.4	Interim Residuals Management Program	3-58
	3.3.5	Long-Term Residuals Management Facilities Plan	3-58
	3.3.6	Water Transportation Facilities	3-59
	3.3.7	Combined Sewer Overflow Program	3-59
	3.3.8	Harbor Research and Monitoring	3-59
	3.3.9	Wastewater Transport Program	3-59
3.4	Project Milestones		3-63
4.0	Basis of Institutional Plan		4-1
4.1	Objectives		4-1
4.2	Recommended Facilities Plan		4-2
	4.2.1	Site Layouts	4-2
	4.2.2	Plant Utilities	4-9
	4.2.3	Estimated Costs	4-12
	4.2.4	Construction Considerations and Schedule	4-13
	4.2.5	Operation and Maintenance Organization	4-14
	4.2.6	Environmental Considerations	4-15
	4.2.7	Institutional Considerations	4-21
4.3	Institutional Factors		4-22
	4.3.1	Project Schedule	4-23
	4.3.2	Program Management Requirements	4-24
	4.3.3	Financing Requirements	4-24
	4.3.4	Human Resources Requirements	4-24
	4.3.5	Legislative and Regulatory Issues	4-25
5.0	Project Schedule		5-1
5.1	Construction Plan		5-1
	5.1.1	Construction Sequencing and Schedule	5-2
5.2	Construction Packages		5-5
	5.2.1	CP1 - Site Preparation I, 1988-1991	5-6
	5.2.2	CP2 - Power and Electrical Facilities 1988-1995	5-8
	5.2.3	CP3 - Nut Island of Headworks, Inter-Island Wastewater Conveyance Tunnel and South Flow Pump Station, 1990-1994	5-8
	5.2.4	CP4 - Effluent Outfall, 1990-1995	5-9

5.2.5 CP5 - Primary Treatment Facilities, Zone A (Phases 1 and 2) on a Zone B (Phase 3), 1991-1995 5-9
5.2.6 CP6 - Residuals Phase 1, 1991-1995 5-12
5.2.7 CP7 - Site Preparation II, 1992-1995 5-12
5.2.8 CP8 - Secondary Treatment Facilities, Zone A and Zone B, 1995-1999 5-13
5.2.9 CP9 - Residuals Phase 2, 1995-1999 5-13
5.2.10 CP10 - Site Preparation III, 1996-1999 5-16
5.3 Construction Quantities 5-16
5.3.1 Excavated Materials 5-16
5.3.2 Concrete Quantities 5-16
5.3.3 Personnel 5-20
5.4 Construction Support 5-20
5.4.1 Pre-Purchase of Equipment 5-22
5.4.2 Overland Transportation 5-23
5.4.3 Overwater Transportation 5-24
5.4.4 Concrete Production 5-24
5.4.5 Materials Handling and Storage 5-26
5.4.6 Laydown Areas 5-27
5.4.7 Office Space Requirements 5-27
5.4.8 Construction Power Requirements 5-27
5.4.9 Site Security 5-29
5.4.10 Innovative Construction Techniques 5-29
5.5 Permitting Plan 5-30
5.5.1 Background 5-30
5.5.2 Identification of Responsible Agencies and Permits 5-31
5.5.3 Issues 5-50
5.6 Construction Scheduling 5-51

6.0 Program Management 6-1
6.1 Objectives 6-1
6.1.1 Organization of the Report 6-1
6.2 Construction Management 6-2
6.2.1 Definition 6-2
6.2.2 The Need for Construction Mangement at MWRA 6-2
6.3 Services Provided by a Construction Management Team 6-4
6.3.1 Planning 6-5
6.3.2 Design Phase 6-5
6.3.3 Construction 6-8
6.3.4 Start-Up 6-10
6.4 Advantages and Disadvantages of Using a Construction Manager 6-10

6.4.1 The Advantages of Construction Management 6-11
6.4.2 The Disadvantages of Construction Management 6-11
6.5 Case Studies: Use of a Construction Management Team 6-13
6.5.1 Organization of the CM Function at the North River Water Pollution Control Plant 6-14
6.5.2 Organization of the CM Function for the Construction of the Depressed Central Artery/Third Harbor Tunnel 6-16
6.5.3 Costs of Construction Management, North River Plant and CA/THT 6-20
6.6 Proposed Strategy 6-20
6.6.1 Decision Factors 6-20
6.6.2 Recommendations 6-24
6.7 Conclusion 6-32

7.0 Financial Impact Analysis 7-1
7.1 Introduction 7-1
7.2 Current Dollar Expenditures 7-2
7.2.1 Capital Expenditures 7-2
7.2.2 Operating Expenditures 7-4
7.3 MWRA Revenue Requirements 7-4
7.3.1 Cash Flow Requirements 7-6
7.3.2 Alternative Scenarios 7-10
7.4 Community Allocations/Impacts 7-17
7.4.1 Communities Analyzed 7-17
7.4.2 Basis for Community Impact Analysis 7-17
7.4.3 Assumptions 7-18
7.4.4 Financial Impact on BWSC 7-18
7.4.5 Financial Impact on Needham 7-21
7.5 Conclusions 7-21

8.0 Human Resources
8.1 Operation and Maintenance Organization 8-1
8.1.1 Prototype Organizational Structure 8-2
8.1.2 Sewerage Division Coordination 8-3
8.1.3 Functional Description 8-5
8.1.4 Position Identification, Placement and Training 8-6
8.1.5 Treatment Plant Control Strategy 8-8
8.2 Training and Staff Development 8-11
8.2.1 Introduction 8-11
8.2.2 Training 8-13
8.2.3 Role of Construction Manager and Lead Engineer 8-24

		8.2.4	Training Program Size and Estimated Costs	8-24
	8.3		Preliminary Operations Plan	8-25
9.0	Regulatory Plan			9-1
	9.1	Regulatory Plan		9-1
		9.1.1	Phase-Out of the Federal Construction Grants Program	9-1
		9.1.2	Creation of State Revolving Loan Funds	9-1
		9.1.3	Phase-Out of the State Construction Grants Program	9-2
		9.1.4	Special Congressional Authorization for the Boston Harbor Clean-Up	9-2
		9.1.5	Tax Reform Act of 1986	9-3
		9.1.6	Limited Authorized Bonding Capacity	9-4
		9.1.7	Ability to Privatize Project Components	9-4
	9.2		Potential Effects of Proposed Regulations	9-4
	9.3		Suggested Modifications to Existing Laws and Regulations	9-5
10.0	Other Institutional Cosiderations			10-1
	10.1	Internal Coordination		10-1
		10.1.1	Mitigation Management	10-1
		10.1.2	Infiltration/Inflow Management Program	10-2
		10.1.3	Harbor Monitoring Program	10-3
		10.1.4	Other MWRA Projects	10-3
	10.2	External Coordination		10-4
		10.2.1	Coordination with the Central Artery/Third Harbor Tunnel Project	10-4
		10.2.2	Coordination with Regulatory Agencies	10-5
Appendix A			Permit Fact Sheet	

Secondary Treatment Facilities Plan
Volume VII
Institutional Considerations
Draft Report
November 13, 1987

List of Figures

Figure No.	Title	Page
1.4.1-1	Summary Project Construction Schedule	1-4
2.1-1	Deer Island and Nut Island Effluent and Sludge Discharge Locations	2-2
2.3-1	Secondary Treatment Facilities Project Planning Schedule	2-7
3.3.5-1	Residuals Management Project Schedule	3-59
3.3.6-1	Water Transportation Facilities Project Schedule	3-61
3.3.7-1	Combined Sewer Overflows Project Schedule	3-62
4.2-1	Deer Island Wastewater Treatment Plant Schematic	4-3
4.2.1-1	Nut Island Site Plan	4-5
4.2.1-2	Recommended Deer Island Facilities	4-7
4.2.1-3	Deer Island External Access	4-8
4.2.1-4	Deer Island Internal Access	4-10
4.2.5-1	Deer Island Wastewater Complex Organizational Chart - Management Plan	4-16
5.1.1-1	Summary Project Construction Schedule	5-3
5.1.1-2	Wastewater Process Treatment Zone A and Zone B	5-4
5.2.1-1	Early Site Preparation for Deer Island, 1988-1990	5-7
5.2.5-1	Primary Treatment Facilities Zone A Complete, 1991-1994	5-10

5.2.5-2	Primary Treatment Facilities Zone A and Zone B Complete, 1991-1995	5-11
5.2.8-1	Secondary Treatment Facilities Zone A Complete, 1995-1998	5-14
5.2.8-2	Secondary Treatment Facilities Zone A and Zone B Complete, 1995-2000	5-15
5.5.1-1	Secondary Treatment Facility Court Mandated Construction and Preliminary Permitting Schedule	5-32
5.5.1-2	Prelimary Permit Plan Schedule Early Site Preparation Deer Island	5-33
5.5.1-3	Preliminary Permit Plan Schedule Utility Supply Deer Island	5-34
5.5.1-4	Preliminary Permit Plan Schedule Inter-Island Wastewater Transport System Deer Island	5-35
5.5.1-5	Preliminary Permit Plan Schedule Treatment Plant Deer Island	5-36
5.5.1-6	Preliminary Permit Plan Schedule Effluent Outfall Facilities Deer Island	5-37
6.6.2-1	Table of Multiple Program Responsibilities, Program Management Unit	6-25
6.6.2-2	Table of Organization, Program Management Unit	6-26
6.6.2-3	Table of Organization, Management of Individual Projects	6-31
7.3.1-1	Wastewater Construction Cost by Year	7-8
7.3.1-2	Projected Annual Wastewater Costs	7-12
7.4.4-1	Comparison of One-Family Sewer Bills Town of Needham, Massachusetts	7-23
7.4.5-1	Comparison of One-Family Sewer Bills Boston Water and Sewer Commission	7-27
8.1.1-1	Deer Island Wastewater Treatment Complex Organizational Chart - Management Team	8-4

Secondary Treatment Facilities Plan
Volume VII
Institutional Considerations
Draft Report
November 13, 1987

List of Tables

Table No.	Title	Page
5.3.1-1	Sources and Volume of Excavated Material	5-17
5.3.1-2	Proposed Disposal Options for Excavated Material	5-18
5.3.2-1	Concrete Quantities	5-19
5.3.3-1	Estimated Daily Construction Worker Volume, by Year (1991-1999)	5-21
5.5.2-1	Permit List	5-39
5.5.2-2	Project Permitting Matrix	5-44
6.3-1	Construction Management Services	6-6
6.5.1-1	Responsibility Marix, Agency and CM Team, NYC/DEP North River Plant Project	6-17
6.6.2-1	Proposed Responsibility Matrix, MWRA and CM/LE Team	6-29
7.2-1	MWRA Cash Flow Analysis Current Dollar Cash Flow Projection	7-3
7.3.1-1	Inflated Dollar Cash Flow and Grant Protection	7-7
7.3.1-2	Cash Flow Summary and Project Debt Service	7-9
7.3.1-3	Projected Operating Costs and Reserve Deposits	7-11
7.3.2-1	Variables Under Base Case and Alternatives	7-13

7.3.2-2	Comparison of Net Capital Cash Flow (Base Case and Alternatives)	7-15
7.3.2-3	Comparison of Annual Revenue Requests (Base Case and Alternatives)	7-16
7.4.4-1	Projected Expenses - Boston Water and Sewer Commission	7-19
7.4.4-2	Projected BWSC Sewer Rates and Financial Impacts	7-20
7.4.4-3	Comparison of One-Family BWSC Residental User's Sewer Bill Base Case and Alternatives	7-22
7.4.5-1	Projected Expenses - Town of Needham	7-24
7.4.5-2	Projected Needham Sewer and Tax Rates Plus Financial Impacts	7-25
7.4.5-3	Comparison of One-Family Needham Residential User's Sewer Charges	7-26
8.3-1	Dear Island Wastewater Treatment Complex Preliminary Plan of Operation	8-26
8.3-2	Conceptual Plan of Operation	8-31

Section 1

1.0 SUMMARY

1.1 PROJECT IDENTIFICATION

The following report is Volume VII, Institutional Considerations, of the Secondary Treatment Facilities Plan. It is one of the seven volumes that constitute this plan.

1.2 BRIEF DESCRIPTION OF PROJECT

The Secondary Treatment Facilities Plan evaluates the facilities needed to provide primary and secondary treatment of the wastewater conveyed through the Massachusetts Water Resources Authority's North and South Sewage Collection Systems at a single treatment facility to be located on Deer Island. The Facilities Plan also evaluates the facilities needed to convey the South System flows from the existing Nut Island Plant to Deer Island, and the outfall facilities needed to convey the treated combined flows from Deer Island to a disposal point in marine waters.

1.3 ORGANIZATION OF THE REPORT

Volume VII, Institutional Considerations, identifies the permitting, program management, financing, human resources and regulatory requirements for constructing and operating the recommended facilities within the schedule entered by the Federal Court. The analysis includes a review of the court-ordered target dates and recommends any changes in the schedule that are deemed necessary.

Volume VII is organized in the following manner:

- Section 2, Introduction, describes the need for the Boston Harbor Clean-Up Program and outlines the scope of activities conducted during the facilities planning effort.

- Section 3, Project Background, summarizes previous studies for the clean-up of Boston Harbor, outlines the process of decision making on the siting of the new facilities and presents the court-ordered target dates for completion of the Facilities Plan.

- Section 4, Basis of Institutional Plan, describes the major institutional issues that are examined in this volume.

- Section 5, Project Schedule, contains plans for permitting and constructing the facilities. The permitting plan identifies the necessary permits and establishes a schedule for obtaining the required permits for each of the major project components. The construction plan describes the sequencing of construction activities into discrete production packages, estimates the required quantity of labor and bulk materials associated with construction, and outlines organizational options for providing major support activities such as concrete production, overwater transportation and pre-purchase of equipment. The critical activities which must be completed to ensure compliance with the schedule are also described in this section.

- Section 6, Program Management, analyzes the means by which the Authority can expand its capability to manage large, complex capital projects.

- Section 7, Project Financing, estimates the annual cash flow required for the construction of the proposed facilities and projects the financial impact of the recommended plan on MWRA customers in three representative communities.

- Section 8, Human Resources Plan, describes the staffing and training requirements necessary to provide the administrative and technical capability for operating the new primary and secondary treatment facilities.

- Section 9, Regulatory Plan, identifies recent legislative and regulatory changes, or proposes additional changes, which will affect the MWRA's ability to implement the facilities plan.

- Section 10, Other Institutional Considerations, describes internal and external (non-MWRA) capital projects and management initiatives with which MWRA must effectively coordinate its activities in order to construct the proposed wastewater treatment facilities.

1.4 MAJOR CONCLUSIONS

The major conclusions of this volume are summarized below:

1.4.1 PROJECT SCHEDULE

The target dates entered by the Federal Court for the construction of the treatment facilities, outfall and inter-island wastewater conveyance system are as follows:

o	Initiate construction of new primary treatment facilities	12/90
o	Complete construction and commence operation of new primary treatment facilities	7/95
o	Initiate construction of outfall	7/91
o	Complete construction of outfall	7/94
o	Initiate construction of inter-island wastewater conveyance system	4/91
o	Complete construction of inter-island wastewater conveyance system	4/94
o	Initiate construction of secondary treatment facilities	during 1995

- Complete construction of secondary treatment facilities during 1999

The target dates formed the initial basis for developing the preliminary Summary Project Construction Schedule shown in Figure 1.4.1-1. This preliminary schedule shows a logical way of constructing the secondary treatment facilities in accordance with acceptable construction methods and practices to meet the court-imposed schedule dates. The schedule recognizes the project's complexity in terms of limited site availability, the large quantities of excavated materials, and the need for water transport of vast amounts of equipment, personnel and materials. The schedule includes limited provisions for such foreseeable risks as weather, but it does not address such events as worker disputes, strikes and Acts of God. These acts, and their impacts on the schedule, will be identified, recorded and monitored by the Program/Construction Management team retained by the Authority to manage the day-to-day project activities.

The schedule also illustrates the division of the major construction activities into manageable construction packages. The schedule also reflects the anticipated permitting, agency review, design, bid and award periods for each construction package. The design, bid and award periods for each construction package are phased to allow for the necessary coordination and monitoring of the many contractors to be working on Deer Island at the same time, and to facilitate the ferrying of workers and construction materials from the off-island pier facilities. The preliminary construction packages are:

- Site Preparation I, 1988-1991
  - Early Site Preparation, 1988-1990
  - Completion of Site Preparation I, 1990-91

- Power and Electrical Facilities, 1988-1995
  - Immediate Power, 1988-1990
  - Long Term/Permanent Power, 1988-1995

- Nut Island Headworks, Inter-Island Wastewater Conveyance Tunnel, and South System Pumping Station, 1990-1994

- Effluent Outfall, 1990-1995

- Primary Treatment Facilities

  Zone A, Phase 1 -- 1991-1993
  - Main Pump Station and Winthrop Terminal Modifications
  - North System Force Main

  Zone A, Phase 2 -- 1991-1993
  - Grit Facilities
  - Control Building
  - Odor Facility
  - Administration Building

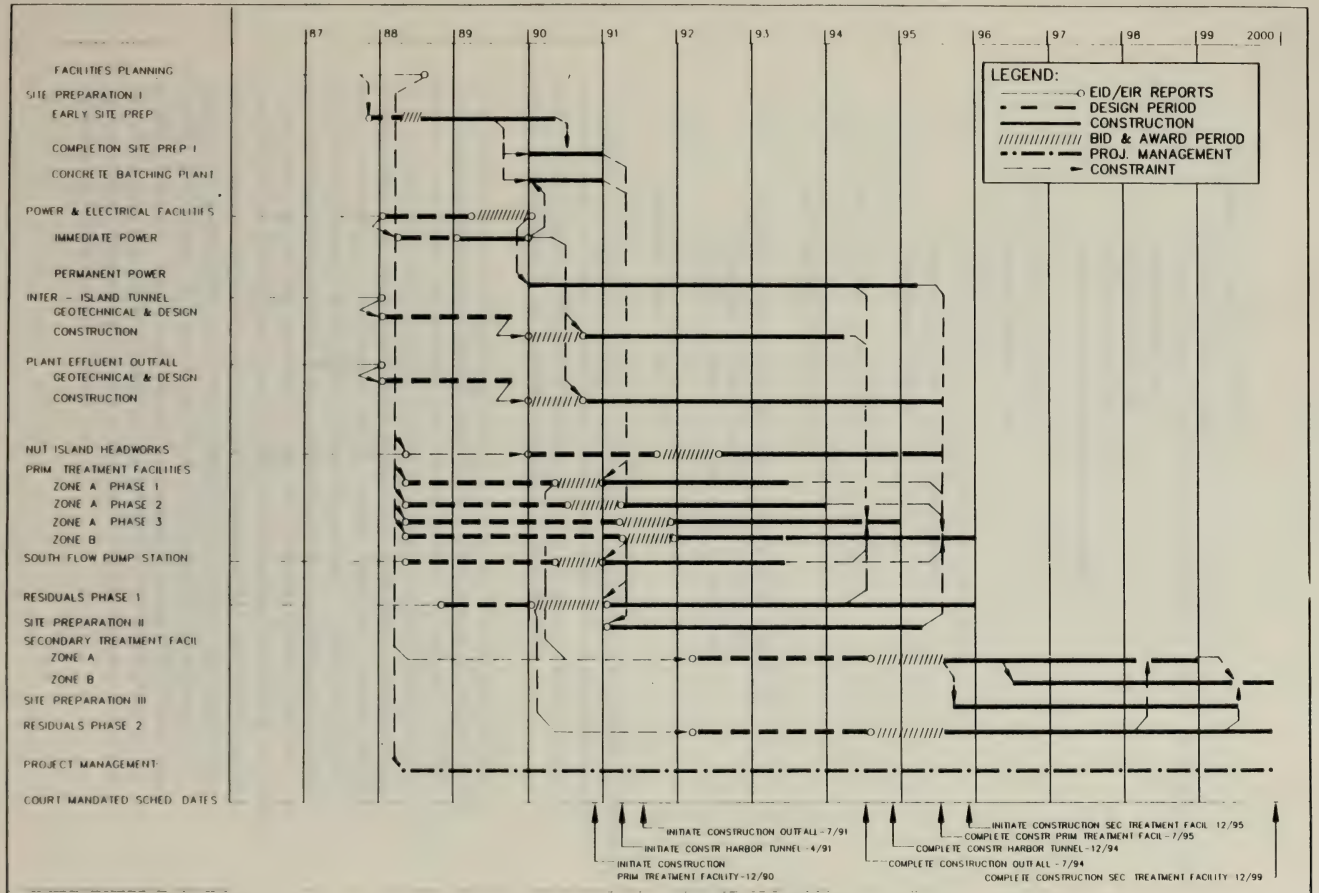

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FIGURE 1.4.1-1
SUMMARY PROJECT CONSTRUCTION SCHEDULE

Zone A, Phase 3 -- 1992-1994
- Primary Clarifiers 1 and 2
- Temporary primary conduit connecting Selectors 1 and 2 to the existing outfall
- Primary splitter box
- Secondary splitter box
- Primary screening facilities
- Primary sludge and scum pumping galleries

Zone B, Phase 4 -- 1992-1995
- Primary clarifiers 3 and 4
- Selectors 3 and 4
- Temporary conduit from Selector Zone B to existing outfall
- Primary sludge and scum pumping galleries
- Maintenance Building

o Residuals Phase I, 1991-1995

o Site Preparation II, 1992-1995

o Secondary Treatment Facilities, Zone A and Zone B, 1995-1999
- Secondary Treatment Facilities, Zone A, 1995-1998
- Secondary Treatment Facilities, Zone B, 1996-1999

o Residuals Phase II, 1995-1999

The preliminary construction schedule is predicated on the construction of complete operational treatment zones (i.e. Zones A and B) rather than on the construction of the entire treatment plant in a single project. This type of planning allows for the early completion, operational testing, and acceptance by the Authority of individual parts of the plant.

Prior to the initiation of construction of Zone A of the new primary treatment facilities, extensive site preparation activities must begin on Deer Island as early as 1988 in order to prepare a level platform for the siting of the primary clarifiers. As part of this 1988-1990 early site preparation effort, described in detail in Volume VI of the facilities plan, the existing outfall pipes will first be protected against heavy construction equipment and/or loads. The existing grit and screenings will be excavated, stabilized as required, and hauled to a previously prepared, doubly lined, on-island disposal area. A major portion of the central drumlin will be excavated to begin preparation of the level platform for construction of the primary facilities and preparation of a site for the concrete batching plant; the excess materials will be used on-island to develop visual and noise barrier landforms at the northern end of the island. Existing structures such as Ft. Dawes and the water reservoir atop the drumlin will be demolished and a new non-potable back-up service water system will be installed (if necessary). The prison area will be used to begin the construction of the northern landforms. Should the prison still be in operation during 1988-90, the existing prison recreation area will be relocated to allow for the use of the existing area for the disposal of excess materials; the south area reserved for residuals facilities will be used to dispose of the remaining excess material.

After completion of the on-island pier facilities, the remainder of the central drumlin will be excavated. By the end of 1990, the concrete batching plant will be completed, the prison facilities demolished if the prison has been decommissioned, and construction will begin on the shafts for the inter-island wastewater conveyance tunnel and the outfall tunnel.

In addition, prior to the start of the construction of the primary facilities in December 1990, installation of additional short-term and permanent power supplies will be required to meet the power needs of operating the existing treatment facility and constructing the two submarine tunnels. An immediate power supply will be installed from Massachusetts Electric Company's Winthrop grid by January 1990 to provide 15 MW of power to support tunnel construction activities.

Construction of the first phase of the permanent power facilities, as detailed in Appendix H of Volume III of the Facilities Plan, will begin by January 1, 1990. Completion of the first underharbor 115 kv permanent feeder from Boston Edison company's K Street station will be accomplished by the end of 1991 to meet the power needs of the primary sludge dewatering facilities, the on-island piers, and basic plant power requirements. The second 115 kv permanent feeder from BECo's Chelsea station and the recommended combined cycle on-island power plant will be completed by January 1995 to meet the needs of the new primary facilities and to satisfy the EPA requirement for an uninterruptible supply should the tie with the utility fail.

The extensive geotechnical exploration program required to support the 1990 design of the inter-island and outfall tunnels will begin in 1988. Based on the estimated advance rates for the tunnel boring machines, construction of the outfall tunnel must begin late in 1990. This start date will allow the outfall to be operational in July 1995 at the same time that the new primary facilities are placed in service.

Construction of the inter-island tunnel could begin anytime from late 1990 to April, 1991. This tunnel will be completed in approximately three years.

Following the completion of the design of Phase 1 of the Zone A primary facilities in early 1990, the construction of the Main Pump Station and Winthrop Terminal modifications and the North System Force Main components of the primary treatment system will begin during December 1990. Construction of the new South System pump station required to lift South System flows up from the inter-island wastewater conveyance tunnel will also begin in 1990 as will the first phase of the new residuals facilities. The second phase of the site preparation efforts will begin in 1990 to prepare the central island area for the construction of the secondary facilities, construct berms in the north and east areas, and handle the outfall and inter-island tunnel spoils.

Concurrently, the design of the remaining two phases of the Zone A primary facilities and the design of the Zone B primary treatment units will continue through the first quarter of 1991. Bidding and award of the construction contracts will allow the remainder of the primary treatment facilities to begin construction from early 1991 to 1992.

Construction of the Zone A primary clarifiers (A and B) and associated works will also be staggered. Phase 1 will be completed by mid-1993. Phase 2 of the Zone A primary clarifiers will be completed by the end of 1994, and Phase 3 by the end of 1994. The phased construction of the primary treatment zones will permit the early operation of the completed primary clarifiers in 1994, resulting in improved treatment and the testing of equipment during the warranty period and under actual operating conditions.

Construction of Zone B (C and D) primary clarifiers and associated works will be completed by July 1995. Operational testing of the new primary treatment facilities will continue through the remainder of 1995. The Nut Island headworks will be operational in mid-1995 when the new primary facilities are available to treat the South System flows. Phase 1 of the residuals facilities will also be available at that time.

Phase II site preparation efforts to prepare the central island area for construction of the secondary treatment facilities will be completed by the end of 1995. This will complete the major earth movement activities on the island, as well as tunnel excavation efforts. The excess materials will either be used to develop on-island noise and visual barriers, or transported off-island for disposal. Construction of the Zone A secondary clarifiers will begin in this central area by the end of 1995 in accordance with the court schedule.

The Zone B secondary clarifiers will begin construction in mid-1996. With the completion of the Zone B secondary clarifiers and Phase II residual facilities by the end of 1999, the new Deer Island Secondary Treatment Plant will be operational. This schedule is only achievable, however, if the following critical path activities are completed on time:

- Implementation of the geotechnical information gathering effort in the spring of 1988 to support the design of the tunnels.

- Initiation of the design of the new primary treatment plant facilities immediately following approval of the Facilities Plan in May 1988.

- Demolition and removal of the Hill Prison by 1989, or the use of the reserved residuals area for disposal of excess excavated materials generated during the Early Site Preparation period.

- Removal and reburial of the existing grit and screenings by 1990.

- Provision of an interconnection with MECo's Winthrop grid by January 1, 1990 to meet the immediate power needs of the tunnel construction efforts.

- Completion of the first underharbor power cable by December 1991, and the on-island combined cycle power plant by January 1990, to meet both construction power needs and operating power needs of the new facilities.

- Completion of outfall construction by July 1995, in time to receive flows from the new primary treatment facility.

- Successful completion of permitting requirements for each project component. Critical among the permitting issues are the need to immediately initiate permitting activities for early site preparation and utilities supply, and the need to develop a strategy for the re-use or disposal of approximately 1.0 to 1.7 million yd^3 of excavated material from Deer Island.

In addition, to ensure that the Deer Island project meets the scheduled completion dates within the project budget, the responsibilities of the Program/Construction Management Team retained by the Authority should include developing, overseeing, coordinating, monitoring, and administering all Deer Island secondary treatment facilities contracts related to the following programs:

- Equipment Pre-purchase -- the completion of construction on an optimum schedule may require extensive pre-purchase of critical equipment items.

- Overwater Transportation -- upon completion of the on-island pier facilites in 1989, at least 50 percent of the estimated peak workforce at Deer Island will be transported over water to the on-island job site via ferries from on-shore satellite parking facilities. In addition, the vast majority of construction materials and equipment, as well as operations supplies, will be transported to Deer Island by roll-on/roll-off vehicles delivered by boats and/or barges traveling between the on-shore and on-island piers.

- Overland Transportation -- A maximum of 50 percent of the peak workforce will be bused to Deer Island from designated satellite parking areas.

- Concrete Production -- The total demand for concrete ranges from 0.8 to 0.95 million yd^3 depending on the length of the outfall. The peak demand years are 1992 and 1993, which will overlap with the peak demand years of the Central Artery/Third Harbor Tunnel Project.

The organizational approaches for providing these necessary construction support activities are outlined in Section 5. A final determination by the Authority should await a thorough analysis by the Program/Construction Management team.

1.4.2 PROGRAM MANAGEMENT

The overwhelming logistical requirements and strict court-ordered schedule associated with the facilities plan mandate that MWRA immediately expand its capability to manage large-scale, complex capital projects. The recommended steps for achieving this objective are:

- Create and staff an in-house Program Management Unit dedicated to monitoring the Agency's most complex capital projects. The role of this unit will be to provide executive control and direction, monitor the performance of consultants and act as a liaison between consultants and other MWRA divisions.

- Retain a Program/Construction Manager (P/CM) who will assume primary responsibility for day-to-day program management including the supervision of design, cost estimating, scheduling, permitting, value engineering, pre-purchase of equipment, resident engineering, facility testing and staff training. In addition, the P/CM will provide technical support for the Authority's decisions regarding contractor selection, change order control, progress payments and final acceptance.

- Retain a Lead Design Engineer who will assume responsibility for directing the design of the primary and secondary treatment facilities including the tunnels, power plant and on-site residuals management facilities. The Lead Engineer will develop design standards, provide drawings at the 10-15 percent completion level for all facilities, prepare a final design of the priority design packages, and oversee selected designers for the other design packages. The work of the Lead Engineer will be managed from an overall program perspective by the P/CM with particular emphasis on schedule, budget and constructibility issues.

- Request that the federal and state regulatory agencies immediately assign a liaison to the MWRA's Program Management Unit to ensure effective coordination with the regulatory agencies in permitting and mitigation requirements.

1.4.3 PROJECT FINANCING

The construction of new facilities to clean up Boston Harbor and provide adequate sewerage service to the Metropolitan Boston area will entail a major financial commitment. In current-day dollars, it is estimated that new MWRA facilities related to these projects will cost approximately $3 billion. Since construction of these facilities will continue through the century, inflation will increase the actual cost. Once the facilities are constructed, the MWRA will have the additional responsibility and cost of operating the new facilities. The funds to construct and operate these facilities, if not derived from external sources (grants or loans) must be recovered through the Authority's charges to member communities.

The financial impact analysis contained in Volume VII focuses on three major components:

- Current Dollar Expenditures -- which describes the expenditures required annually, in current-day dollars, for construction and operation of new and existing facilities. The Capital costs are identified for the facilities included in the Deer Island Secondary Treatment Facilities Plan, other capital projects contained in the Authority's draft 1988 Capital Improvements Program, collection system projects identified as part of the EMMA study, and an allowance for miscellaneous divisional capital projects and allocated capital projects of the Authority's support divisions. No costs associated with future CSO projects are included in this analysis.

  Operating costs include the direct costs of the sewerage division, plus an allocation for other Authority operating expenses. Current MWRA operating costs are based on the FY 1988 operating budget. The existing operating costs for FY 1989 and FY 1990 are based on the MWRA's preliminary budget estimates for wages. Future year costs include

the increased operating expenses associated with primary and secondary treatment, residuals management and the water transportation system.

- MWRA Revenue Requirements -- which projects the amounts in future dollars which must be raised by charges to the member communities to retire the debt associated with the construction program and to pay operating expenses. In estimating the amounts to be raised through charges, several different variables were considered. These include economic variables, such as anticipated rates of inflation, and financial variables, such as terms and rates for bond issues and the availability of grants-in-aid and/or loans from state and federal grants.

  In order to evaluate the range of effects which different assumptions about the variables might produce, a base case and four alternatives were constructed. The base case represents a prudent scenario: reasonable estimates of future economic and financial variables are made, and grants-in-aid are assumed to be available only to the extent to which these grants have already been committed to the Authority through FY 1988. Alternative 1 is similar to the base case, but assumes higher inflation and bond interest rates, plus a shorter term on the Authority's revenue bonds. Alternative 2 uses the base case assumptions, but also assumes the institution of a State Revolving Loan Program with a maximum annual loan amount of $50 million with interest at half the normal market rate. Alternative 3 is similar to Alternative 2, but assumes a more attractive State Revolving Loan Program with zero-interest loans and $100 million available per year. Alternative 4 is a "best likely case" scenario, assuming lower inflation rates and a low-interest State Revolving Loan Program in conjunction with a new grant program of 25%, with a maximum grant amount to the MWRA in any given year of $100 million. (See Table 7.3.2-1.)

- Community Allocation/Impacts -- which investigates the impacts of the MWRA charges on users served by two member sewerage divisions, the Boston Water and Sewer Commission and the Town of Needham. These two members were selected because they represent a fully self-sufficient local utility, and one which raises some of its wastewater expenses from tax levies. These approaches are representative of the local financing methods in use in the service territory.

The current dollar value cash flow estimates are presented by project in Table 7.2-1. The total cost of Deer Island-related projects is $1.87 billion with annual expenditures reaching a peak of $260 million in FY 1992. The total dollar value cash flow for all projects (Deer Island and non-Deer Island) is $2.9 billion.

Table 7.3.1-1 presents the inflated annual construction costs and estimated annual grant receipts for each construction package or project. The values represent the present-day construction cost estimates presented in Table 7.2-1 with increases based on an assumed inflation rate of 6 percent. Assumed federal and/or state construction grants (for those projects on the FY 1988 Fundable list) are deducted from these inflated costs to determine the net cost to the Authority each year. Figure 7.3.1-1 graphically presents the wastewater-related construction costs and grant receipts by year.

Table 7.3.1-2 presents a summary of cash flow for construction-related costs for the base case scenario. This table presents the net (less grants) construction costs, the estimated amount of annual Authority revenue bond issues, the Authority's total debt service payments, and annual debt service reserve deposits. Table 7.3.2-2 compares the annual cash flow requirements of the base case with the four alternatives.

Table 7.3.1-3 presents the total estimated annual wastewater operating costs for the Authority. Figure 7.3.1-2 presents the Authority's projected annual revenue requirements including total debt service, operating costs and reserve deposits by year. Table 7.3.2-3 summarizes the annual revenue requirements under the base case and the alternatives.

The cost of financing the annual revenue requirements (net of grants and other sources of income) will fall on the users within the MWRA service area. The increased annual sewer charges will not impact all properties to the same degree. MWRA member communities pass the Authority's charges on to their own retail customers in a multitude of ways. These methods range from full recovery of the Authority charges through the communities' retail sewer rates to full or nearly-full recovery through ad valorem property taxes.

As noted previously, the financial impact on users in two different communities were analyzed. While it is intended that the analysis be useful in determining the relative impact in all communities, it must be recognized that the number of different cost recovery mechanisms used and the diversity among MWRA member communities make a direct comparison between any two communities invalid.

The impacts presented for the two communities, Boston and Needham, are intended to show the total cost of providing wastewater service in each community over the remainder of the century. As such, the costs of each community's wastewater utility operations include the projected MWRA charges as well as projections of the communities' current local operating and capital (including debt) costs. The analysis of the future costs and needs in the communities is necessarily not as extensive as that performed for the Authority, and thus may understate the communities' future local costs.

Table 7.4.4-3 presents the annual sewer bill (not including water) for a typical single-family residential customer in Boston under the base case and alternative assumptions. In the base case, the fee will increase from the current $100 per year to approximately $660 per year by the year 2005. In the "best case" the fee will increase from $100 to approximately $420; in the "worst case", the fee rises from $100 to about $1200. In evaluating this impact, it must be remembered that this sewer bill will be paid in inflated, year 2005 dollars.

Table 7.4.5-3 presents the estimated future wastewater costs (sewer bill plus property tax) for a typical residential user in Needham. This analysis reflects Needham's

policy of wastewater expense recovery whereby the amount of the last MDC assessment prior to the creation of the MWRA plus all local wastewater-related expenses are recovered through the Town's property taxes.

Under the base case assumptions, the fee for a typical residential user in Needham will increase from $137 to approximately $800. In the "best case," the fee will increase from approximately $137 to approximately $500; in the "worst case" the fee will use from $137 to over $1400.

All costs and financial impacts have been presented in terms of inflated dollars to account for expected increases in construction and operating costs in future years. Accordingly, all projected sewer assessments and retail bills would be paid in future dollars as well. To determine the impact in current-day dollars, an analysis was made assuming no inflation. Total construction costs would be as presented in Table 7.2-1. Annual (sewer only) bills would increase to approximately $400 per year for a single-family user in FY 2005 in Boston and Needham under the base case assumptions with no inflation.

While construction and operation of new facilities to clean up Boston Harbor will be a significant cause in the projected increases in MWRA assessments and retail sewer bills, it must be acknowledged that these existing charges would increase due to inflationary impacts. To determine the impact of the Boston Harbor Clean-Up Program, an analysis of projected assessments and retail sewer bills was made assuming (1) no new construction other than the projected administrative, interceptor and pumping station projects and (2) no new operating costs associated with new facilities. Without the required construction projects and associated operating costs, retail sewer bills in Boston and Needham would still increase to approximately $200 for a single-family user under the base case assumptions.

To alleviate the financial burden on local ratepayers, the following actions are recommended:

- Creation of a State Revolving Fund (SRF) which will supply low-interest loans for financing wastewater plants. The SRF would be capitalized with an 80 percent federal contribution (as authorized in the 1987 Clean Water Act) and a state contribution of 20 percent.

- Re-authorization of the State Construction Grants Program which currently provides financing for 55 percent (or more) of eligible project costs.

- Expedition of early site preparation and design activities to maximize the use of the existing Federal Construction Grants program prior to its expiration in FY 1990.

- Use of value engineering and construction innovations to maintain cost control through the design and construction phases.

1.4.4 HUMAN RESOURCES NEEDS

The best-planned, designed and constructed wastewater facilities will not perform properly unless staffed by qualified, adequately compensated, dedicated and appropriately trained and managed personnel. MWRA's new treatment facilities will require a significant expansion in the number of staff, the degree of staff skills and the systems used to operate and maintain the existing MWRA facilities.

By 1995, MWRA's facilities will require a staff of 419. At project completion in 1999, a staff of 540 will be needed to operate the facilities. This staffing requirement is more than double the number of existing staff. It is necessary, therefore, that MWRA expand its operational capability concurrently with the building of the facilities.

To prepare for facilities start-up, it is essential that the following activities be initiated in spring 1988 and completed by 1991: (1) development of a preliminary plan of operation; (2) adoption of an organizational structure; (3) preparation of position descriptions, salary levels, benefits packages and hiring schedules; and (4) development of critical management control systems such as maintenance management, safety, emergency response and septage receiving.

The ability to meet the staffing requirements is complicated by unique local and regional factors including: (1) the Boston Harbor (island) location of the facilities; (2) the difficulty in commuting to the facilities; (3) the strong competition for skilled labor; (4) the lack of a large pool of personnel with wastewater-related skills and experience; and (5) the area's economic climate, particularly the high cost of housing.

These difficulties must be overcome as the proper placement of staff in the required positions is also a critical issue in starting up the treatment facilities in a phased program. The phased approach places a heavy demand on the management staff to ensure that existing personnel are in place and properly trained in a continuing effort to meet the required effluent limits.

A well-conceived and managed recruiting plan, in conjunction with competitive compensation and attention to the provision of special transportation and scheduling accommodations, will assist in meeting the skill and staffing requirements. In addition, the MWRA should evaluate the use of private contractors to operate certain key areas of the recommended facilities. The power and oxygen generation systems are prime facilities that should be considered for private operation. The overall maintenance program should be carefully evaluated to determine whether certain other maintenance tasks could be performed most effectively by highly-qualified and specialized private contractors and equipment vendors.

The MWRA also should use private contractors to conduct or assist in conducting the necessary training programs. An outside contractor could provide training, including setting up the temporary training center, preparing the materials, providing instruction and establishing an evaluation system. An alternative approach is to have treatment plant staff participate as part of the contractor team. This approach would provide a learning experience for plant training staff in the preparation of training materials, lesson plans, visual aids, instruction and organization of future programs.

The final approach for recruiting and training operating staff should be developed by the Authority, in consultation with the Program and Construction Manager (P/CM) and Lead Design Engineer (LE) retained for the Deer Island-related construction effort. A thorough discussion of the issues and preliminary recommendations relating to on organizational structure, skill requirements, number of staff, management control systems, training and staff development procedures is presented in Section 8, Human Resources Plan.

1.4.5 REQUIRED LEGISLATIVE AND REGULATORY ACTIONS

The legislative and regulatory actions necessary for constructing the recommended facilities pertain to capital financing mechanisms. The two major items are:

- Elimination, or substantial modification, of the current $600-million ceiling on the MWRA's borrowing capacity.

- Obtaining of clear legislative authority to contract, if deemed desirable, with private-sector firms for the simultaneous responsibility of designing, building, and/or operating some or all of MWRA's facilities.

1.4.6 INTERNAL AND EXTERNAL COORDINATION REQUIREMENTS

Implementation of the facilities plan will require a high level of coordination by the Authority of its own capital projects and management initiatives as well as coordination with other non-MWRA projects. The major related MWRA projects include:

- MWRA Capital Projects -- a series of capital initiatives designed to upgrade the current treatment capability and to plan future programs for residuals management and reduction of Combined Sewer Overflows.

- Mitigation Management -- the development of an internal management mechanism to ensure that the Authority will carry out its commitments to Winthrop, Boston, Quincy, and other affected communities. The success of the Deer Island facility and the overall reputation of MWRA will depend largely on its ability to be a "good neighbor" to those who reside near or are affected by its facilities.

- Infiltration/Inflow (I/I) Management Program -- the development of an Authority program to manage the level of I/I entering the wastewater treatment system, thereby enhancing the performance of the new facilities and diminishing the need to build additional capacity into the system.

The major external coordination requirement is to maintain close contact with the Central Artery/Third Harbor Tunnel project directed by the Massachusetts Department of Public Works (MDPW). Joint planning may uncover opportunities for cooperative projects. Specific areas of cooperation might include: (1) re-use or disposal of excavated material; (2) concrete and labor supply; (3) shared pier facilities; and (4) sequencing of construction bids.

Section 2

2.0 INTRODUCTION

2.1 PROJECT NEED

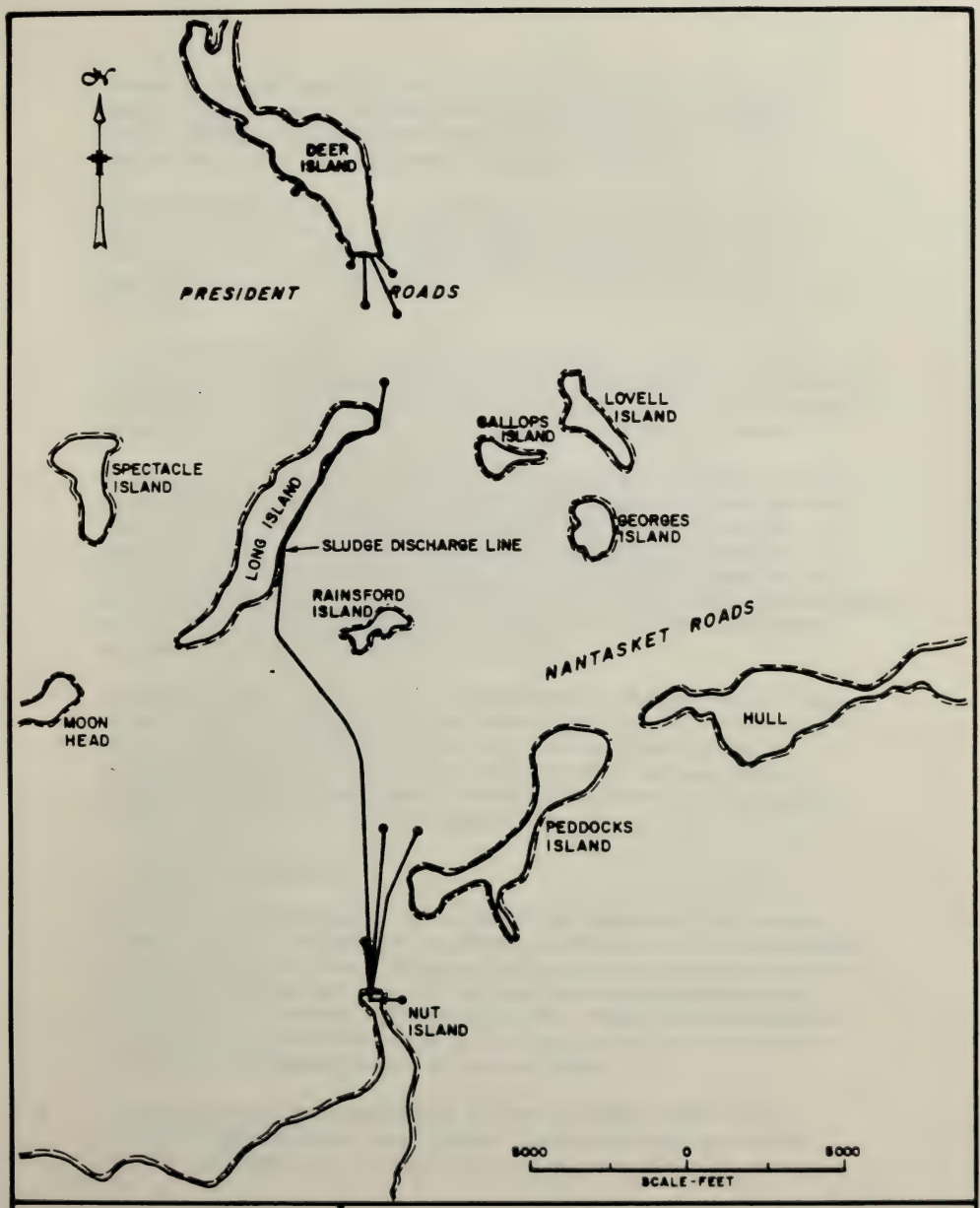
Since the time of the Revolutionary War, Boston Harbor has been considered a national landmark. The largest seaport in New England, it supports a variety of marine activities including shipping, fishing, boating and recreation. It encompasses an area of 47 square miles bordered by residences, commercial buildings, restaurants, marinas, beaches, industries and shellfishing flats. But since the settlement of Boston's shore areas, and most particularly since the City of Boston took possession of Deer Island for "sanitary purposes" in 1847, the Harbor has been the receiving water for all of the domestic, commercial and industrial wastewater and stormwater from the Boston metropolitan area.

Today, nearly 5,000 miles of sewers, conduits and pipes collect sewage from 1.9 million people and 43 metropolitan cities and towns and transport it to the area's two sewage treatment plants at Nut Island and Deer Island for treatment prior to discharge to Boston Harbor. Both of the plants are designed to provide primary treatment. Each plant provides disinfection of the primary effluent prior to discharge to the Harbor to reduce the levels of pathogenic bacteria. The disinfected effluent from Deer Island is discharged through two diffuser equipped outfalls into President Roads approximately 1,500-2,000 feet from Deer Island. Two additional relief outfalls are located 500-750 feet from Deer Island.

The disinfected effluent from Nut Island is discharged north through two main outfalls into Nantasket Roads approximately 4,500-5,000 feet from Nut Island. During periods of high flows and/or extremely high tides a third outfall extending about 1,500 feet north into West Gut side of Hingham Bay may be used. In addition, an emergency outfall extends 500 feet into the Hingham Bay side of West Gut.

The sludges removed from both plants are anaerobically digested and discharged into President Roads on the outgoing tide. Figure 2.1-1 illustrates the location of each of the treatment facilities and discharge locations. The combined discharge of primary effluent and sludge to the relatively shallow waters of Boston Harbor imposes a significant burden on the marine ecology in the waters surrounding the discharge. The discharge of floatable materials results in a significant deterioration in the aesthetic qualities of this vital resource. Because these discharges are but a few of the total discharges to Boston Harbor, and because scientific research to delineate the impacts of each discharge on the Harbor has been limited to date, the precise impacts of the primary effluent and sludge are difficult to quantify. However, these discharges are unquestionably very sizable and the materials being discharged are ecologically significant. Thus, every reasonable effort should be made to reduce these discharges.

The Deer Island treatment facilities were constructed in 1968, and the Nut Island treatment facilities in 1952. Both facilities have exceeded their useful lives and the levels of treatment provided are often less than optimal because of the unavailability of replacement equipment. Nut Island has recently undergone a rehabilitation of most of its major components. A similar rehabilitation is now underway for Deer Island. Rehabilitation of the existing



MASSACHUSETTS WATER RESOURCES AUTHORITY

FIGURE 2.1-1
DEER ISLAND AND NUT ISLAND EFFLUENT AND SLUDGE DISCHARGE LOCATIONS

treatment facilities will optimize the levels of removal that these facilities can consistently provide. However, even the rehabilitated facilities cannot provide the levels of treatment desired. The design criteria and installed equipment of the existing primary facilities do not represent state-of-the art technology; therefore, they require replacement.

The 1972 Federal Clean Water Act requires that all municipal sewage treatment systems incorporate secondary treatment. Secondary treatment is more complex than the primary treatment that the flows at Nut Island and Deer Island currently receive, removing significantly higher levels of both organic materials and solids from wastewater (80 to 90 percent).

Like the Federal Water Pollution Control Act, the Massachusetts Clean Water Act requires promulgation of water quality standards for waters within the Commonwealth. The Massachusetts Division of Water Pollution Control has established these standards to satisfy the requirements of both acts. Thus, both Federal and State statutes require increased levels of treatment.

In 1982, the City of Quincy filed a suit against the Metropolitan District Commission (MWRA's predecessor agency) charging violations of laws prohibiting discharges into coastal waters and tidal waters, and violations of the common law of nuisance. As the suit progressed, the Massachusetts Water Resources Authority was created by the Massachusetts legislature. Almost simultaneously with MWRA's creation, the U.S. Environmental Protection Agency filed suit against MWRA alleging violations of the Clean Water Act. The Federal District Court found MWRA to be in violation and ordered the Authority to plan and construct new treatment facilities in accordance with an aggressive schedule (see Section 3.4.)

The need for upgraded and expanded treatment facilities to serve the Boston metropolitan area is clear: current discharges place a significant burden on one of the area's vital natural resources; the existing treatment facilities have long exceeded their useful lives; the existing treatment facilities do not reflect state-of-the-art technology and design; Federal and State statutes require enhanced levels of treatment; and the Federal Court has intervened and ordered an upgrading of the treatment facilities.

2.2 PLANNING APPROACH

This facilities planning study provides the foundation for the Massachusetts Water Resources Authority's program for the construction and operation of new primary and secondary wastewater treatment facilities at Deer Island. This planning has been approached with the understanding that the facilities planning effort must secure and sustain the acceptance and support of the diverse community, government and business interests that it affects. Therefore, the planning process was based not on technical strength alone, but also on the continual reconciliation of political, legal, environmental, economic and community interests.

A critical component of the facilities planning for secondary treatment facilities has been completed: the siting of the new treatment facilities. The decision-making process and the mitigation commitments made during that siting process are considered to be firm guidance for

the planning to be undertaken in this project. (See Section 3.2 for a description of the siting decision.)

The successful treatment of wastewaters from the Boston metropolitan area requires not only that enhanced treatment facilities be provided, but also that reliable, environmentally sound facilities be provided to manage the disposal of the residuals that are the direct by-products of wastewater treatment. The residuals management facilities plan is being conducted as a separate but concurrent study. The facilities needed and the sites being considered for residuals management are quite different from those needed for secondary treatment. However, the schedule for completion of the residuals management facilities plan is similar to the schedule for this plan. In addition, the approach and work plans for both of these planning studies recognize the synergistic relationship of these two plans. Thus, this planning study must be read with full cognizance of the residuals management facilities planning.

The facilities needed to provide secondary treatment include new primary and secondary treatment facilities located on Deer Island; a new conduit to convey the wastewaters from the existing Nut Island plant to Deer Island (inter-island conveyance facilities); and a new outfall to discharge the treated effluent into the ocean. In addition, a fourth component has been identified for the project: early site preparation. Early site preparation is defined as any construction activity that can start at an early date, i.e., before the completion of the on-island piers facilities needed to move the construction materials, equipment and personnel to the Deer Island site. The facilities planning for secondary treatment has thus been broken into four, stand-alone studies:

Treatment Plant, Volume III
Inter-Island Conveyance System, Volume IV
Effluent Outfall, Volume V
Early Site Preparation, Volume VI

To expedite the planning and review process, the facilities planning for secondary treatment has received a designation as a "major and complicated" project under the Massachusetts Environmental Policy Act regulations. The "major and complicated" project designation permits the environmental reviews to be concurrent with, and an integral part of, the facilities planning process. Thus, the documents being prepared to summarize the facilities planning are the same documents which will be used for environmental reviews.

The scope and sequencing of these facilities planning and environmental review activities are described in the following section.

2.3 SCOPE OF WORK

The purpose of the Secondary Treatment Facilities Plan is to evaluate the facilities needed to provide primary and secondary treatment, at a single facility to be located on Deer Island, of the wastewater conveyed through MWRA's North and South Systems. It will evaluate the

facilities needed to convey the South System flows from the existing Nut Island plant to Deer Island, as well as the outfall facilities needed to convey the effluent flows from Deer Island to a disposal point in marine waters. It will also identify and evaluate the construction activities which can occur as part of the Early Site Preparation effort prior to completion of the on-island piers and in preparation for the construction of the primary facilities.

The scope of work for the facilities plan is summarized below.

Project Management provides the overall project management required to ensure that the facilities plan is completed on time, within budget and with high standards of quality.

Data Collection inventories current and planned upgraded equipment and processes, assembles data regarding process equipment, mechanical, structural and hydraulic conditions, operating and maintenance characteristics, and expected useful life. Data Collection also will project flows and loadings, define the planning area, and provide a basis for evaluating further growth. This task will develop performance/removal criteria that will be used to balance the level of treatment required and the outfall location.

Facilities Engineering will characterize the wastewater to be treated, develop initial alternative planning and architectural concepts for Deer Island and ancillary facilities at Nut Island; complete site planning requirements; evaluate the adequacy of existing preliminary treatment facilities and evaluate unit processes for screening and grit removal; evaluate unit processes for primary treatment and residuals collection; evaluate unit processes for secondary treatment and residual collection; evaluate unit processes for disinfection; identify and evaluate the ability to control air emissions; establish alternative noise control methods and prepare a noise control plan for treatment plant operations and construction activities; determine the need for a pilot plant; evaluate the route and construction technology for locating and constructing the inter-island conveyance system and new effluent outfall; select an area for the outfall discharge which will meet water quality standards; characterize the soil and rock conditions under the proposed facility and related wastewater conveyance systems; identify and evaluate treatment processes; evaluate the reliability and flexibility of each of the treatment alternatives; estimate capital costs for the selected facilities and equipment; identify and estimate utility needs; identify operator needs and develop a preliminary operations plan; outline the requirements to operate the existing plants during construction; and provide pre-construction planning.

Institutional tasks include development of an annual cash flow projection required for the construction of the facilities; identification of the financial impacts of the recommended plan on MWRA's customers; identification of proposed changes or additional laws, regulations, legislative restrictions and agreements that may affect the implementation of the facilities plan; description of potential permit and regulatory agency approval requirements and preparation of a preliminary permitting plan; and implementation of a full-scale public participation program.

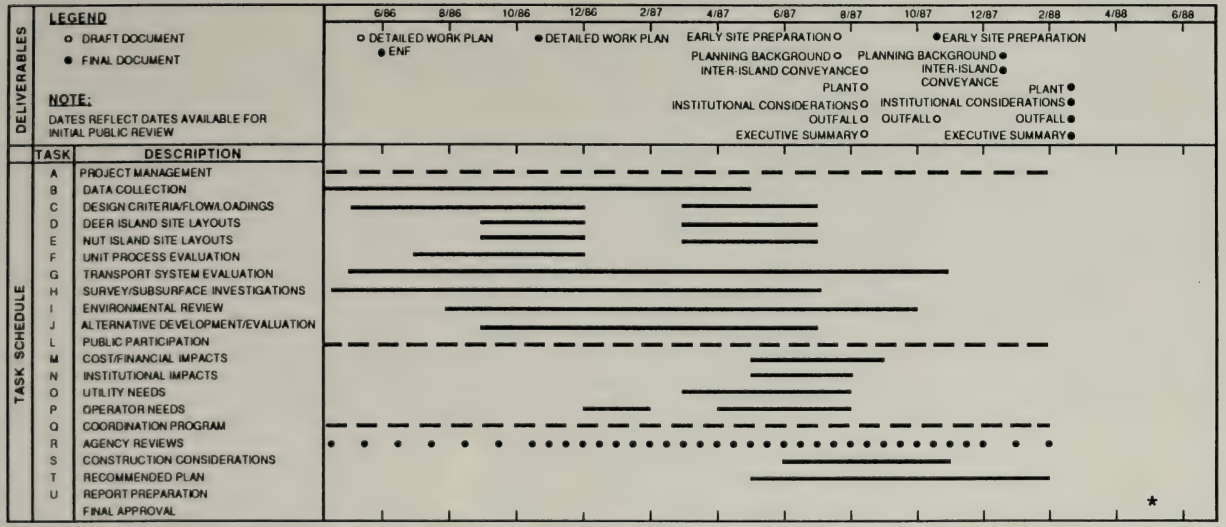
Recommended Plan is the preparation of the Secondary Treatment Facilities Plan and development of an implementation schedule/plan for each design and construction phase, as well as the

coordination of, and response to, reviews by regulatory agencies.

A more detailed outline of each work task will be found in Appendix A. Figure 2.3-1 illustrates the general flow of the planning activities.

SCHEDULE OF MAJOR DELIVERABLES

VOLUME	NAME	DRAFT REPORT	FINAL REPORT
I	EXECUTIVE SUMMARY	9/87	2/88
II	PLANNING BACKGROUND	6/87	12/87
III	WASTEWATER TREATMENT PLANT	9/87	2/88
IV	INTER-ISLAND CONVEYANCE SYSTEM	8/87	12/87
V	EFFLUENT OUTFALL	11/87	3/88
VI	EARLY SITE PREPARATION	7/87	10/87
VII	INSTITUTIONAL CONSIDERATIONS	9/87	2/88



MASSACHUSETTS WATER RESOURCES AUTHORITY

FIGURE 2.3-1
SECONDARY TREATMENT FACILITIES
PROJECT PLANNING SCHEDULE

Section 3

3.0 PROJECT BACKGROUND

3.1 PREVIOUS STUDIES

Since 1900, there has been concern over water pollution problems in Boston Harbor. The State legislature initiated six investigations into the condition of the Harbor between 1900 and 1939. The last of these investigations resulted in the construction of the present Deer Island Treatment Plant which was completed in 1968.

But even as the Deer Island Plant was completed, the Federal Water Pollution Control Administration released a report on the impact of pollution on the Harbor's waters citing recreational, economic and biological impairment. The report generated increased interest in addressing pollution problems and at the first Enforcement Conference on Boston Harbor, state and federal officials agreed on the formation of a technical study group to explore measures for pollution abatement. The recommendations and agreements which grew out of these conferences, in conjunction with the mandates of the Federal Water Pollution Control Act and the Massachusetts Clean Water Act, have formed the framework for attacking pollution in Boston Harbor.

The process of identifying long-term wastewater treatment needs and solutions for the greater Boston Metropolitan area began in 1973 when the Metropolitan District Commission (MDC) began work on wastewater engineering and management planning for Boston Harbor. (Table 3.1-1 provides a list of planning reports for wastewater treatment in Boston Harbor.) The Eastern Massachusetts Metropolitan Area Wastewater Management and Engineering Study (EMMA) was conducted to ascertain what repair, replacement, extension, and expansion of facilities were required to provide adequate sewage treatment for the next fifty years.

In the fall of 1976, following publication of the EMMA Study, EPA's regional office requested that an Environmental Impact Statement (EIS) be prepared before any facilities planning. When the draft EIS was completed in 1978, it resolved the controversy regarding satellite facilities and proposed the consolidation of all planned treatment facilities on Deer Island.

A few months prior to the publication of the EIS, the MDC had responded to the 1977 amendments to the Clean Water Act which provided for a waiver of secondary treatment. If a waiver were granted, much of the construction contemplated in the EMMA Study would be deferred, at least until expiration of the modified permit, and perhaps indefinitely if the permit were renewed. Nevertheless, because regulations pertaining to the waiver process required that facilities plans to provide secondary treatment be prepared concurrently with the waiver process, the MDC, following release of the draft EIS, began preparation of a facilities plan.

Starting in 1983, the EPA and the Commonwealth jointly prepared the Supplemental Environmental Impact Statement/Environmental Impact Report (SEIS/DEIR) on the Site Options Study. The purpose of this document, which augmented the EIS evaluations done on the EMMA Study, was to review the environmental impacts of the Site Options Study alternatives, as well as other alternatives within the context of both the National and Massachusetts Environmental Policy Acts. The SEIS/DEIR started with twenty alternatives and selected seven treatment plant siting

alternatives for final review. The MWRA later reinstated one alternative for final review. Four alternatives involved secondary treatment and four involved primary treatment. The alternatives considered included locating all treatment facilities at Deer Island, all treatment facilities at Long Island, or combinations of plant locations that used Deer, Long, and Nut Islands together in various configurations.

Also in 1983, almost five years after MDC filed a preliminary application for waiver of secondary treatment, the application was tentatively denied by EPA. Because of intervening regulatory developments, MDC was entitled to file an amended application. Shortly thereafter, MDC notified EPA of its intent to do so, and a scope of study was agreed upon, including water sampling to be performed in the summer of 1984. Final submissions were made by MDC in October, 1984.

Although the cost implications of secondary treatment and the ultimate rate-payer impacts promoted pursuit of the waiver application over several years, the waiver application exacerbated two major problems in planning the cleanup of Boston Harbor. First, as long as the "level" of treatment (secondary vs primary) was uncertain, the nature and size of new treatment facilities were impossible to fix for planning purposes. Second, planning for sludge management was frustrated because of the disparity in both the tonnage and character of sludge from secondary treatment as opposed to primary treatment. On March 29, 1985, EPA rejected MDC's amended Section 301 (h) waiver application.

The Massachusetts Water Resources Authority assumed control of the MDC sewerage system on July 1, 1985. The MWRA made the decision to proceed as fast as possible with the secondary treatment program for Boston Harbor, notifying EPA that they would choose a preferred alternative for focused analysis by early July, 1985.

Table 3.1-1 lists planning projects undertaken for Boston Harbor wastewater treatment since the 1976 EMMA study.

3.2 SITING DECISION

The MWRA determined that the seriousness of the siting decision to be made and the newness of the MWRA as a participant in the decision process merited a thorough review of the material presented in the SDEIS/DEIR and comments made pursuant to that document, as well as a consideration of all additional information being developed in response to the issues raised by those comments.

The MWRA began its site selection process by reviewing the six criteria established in the SDEIS/DEIR (i.e., cost, effects on natural and cultural resources, effects on neighbors, harbor enhancement, implementability, and reliability). The MWRA voted to adopt these six criteria, but determined that two additional criteria should be adopted as well: equitable distribution of regional responsibility; and mitigation measures. The first of the new criteria, equitable

TABLE 3.1-1

SUMMARY OF PLANNING REPORTS FOR WASTEWATER TREATMENT IN BOSTON HARBOR

1976, March	Eastern Massachusetts Metropolitan Area Wastewater Engineering and Management Plan of Boston Harbor, Metcalf & Eddy, Inc.
1976	Non-structural Controls for Combined Sewer Overflows, Environmental Research and Technology, Inc.
1976, May	Joint Task Force Report on Major Manned MDC Facilities Located in the Greater Boston Area, EPA Region I
1976, July	Wastewater Management Planning: Boston Metropolitan Area Phase I Study, Urban Systems Research and Engineering, Inc.
1976, July	Phase I Engineering Report Boston Case Study, Kennedy Engineers, Inc.
1976, August	Phase I Final Report on Greater Boston Water Quality Issues in Planning for Pollution Control, Verlex Corp.
1976, November	Boston Metropolitan Area Waste Treatment Feasibility Study, Stone & Webster Engineering Corp.
1979, January	Wastewater Treatment Facilities Planning in the Boston Metropolitan Area - A Case Study, Kennedy Engineers, Inc.
1979, September	Application for Modification of Secondary Treatment Requirements for Discharge into Marine Waters of Boston Harbor and Massachusetts Bay for its Deer Island and Nut Island Wastewater Treatment Plants, MDC
1980, December	MDC Headworks Grit and Screenings Removal Systems - Preliminary Report, Whitman and Howard, Inc.
1982, June	The Commonwealth of Massachusetts Nut Island Wastewater Treatment Plant Facilities Planning Project, Phase I, Site Options Study, Volumes I and II, Metcalf & Eddy, Inc.
1982	Nut Island Wastewater Treatment Plant Immediate Upgrading, Metcalf & Eddy, Inc
1984	Deer Island Facilities Plan, Havens & Emerson/Parsons Brinkerhoff

TABLE 3.1-1
(continued)

SUMMARY OF PLANNING REPORTS FOR WASTEWATER TREATMENT IN BOSTON HARBOR

1984	Supplemental Draft Environmental Impact Statement and Draft Environmental Impact Report, EPA
1984	Application for a Waiver of Secondary Treatment for the Nut Island and Deer Island Treatment Plants, Metcalf & Eddy, Inc.
1985, November	Final Environmental Impact Report on Siting of Wastewater Treatment Facilities for Boston Harbor, Camp Dresser & McKee, Inc.
1985, December	Final Environmental Impact Statement on Siting of Wastewater Treatment Facilities for Boston Harbor, EPA

distribution of regional responsibility, was viewed as subsuming the "fairness" issue which had been the subject of substantial commentary on the SDEIS/DEIR. The second new criterion, mitigation measures, was adopted to ensure consideration of both environmental and non-environmental mitigation and to permit the MWRA to fully respond to mitigation concerns during its siting deliberations.

The MWRA next reviewed the site options to be considered. It voted to examine the seven site alternatives proposed at the conclusion of the SDEIS/DEIR (all secondary Deer Island, split secondary Deer Island and Nut Island, all secondary Long Island, split secondary Deer Island and Long Island, all primary Deer Island, split primary Deer Island and Nut Island, split primary Deer Island and Long Island) and, in response to the Secretary's Certificate of Adequacy on the SDEIS/DEIR, also voted to reinstate for evaluation one site option that had been dropped from consideration at the close of the SDEIS/DEIR (all primary Long Island).

The MWRA then proceeded to an evaluation of each site alternative in the context of the criteria selected. A number of consultants were engaged to assist in the collection, evaluation, and presentation of pertinent materials to the Board members at their publicly held meetings. Oral and visual presentations on each of the eight criteria were given, followed by questions and discussions which refined the issues to be addressed and identified additional information to be obtained. Second presentations and discussions were held on seven of the criteria, and a third round of review and debate occurred on the criterion of cost. As a consequence of these deliberations, further presentations and discussions were held on several sub-topics that were of particular interest or thought to require additional attention.

In addition to its own consultants' presentations, the MWRA heard and discussed presentations by the Regional Administrator of EPA, by representatives of the Executive Office of Environmental Affairs and the Department of Environmental Quality Engineering, and by the technical and legal representatives of the Town of Winthrop and the City of Quincy. In all, the MWRA listened to and discussed at some length, 23 separate presentations on 13 different topics applicable to the preferred alternative siting decision.

A summary of all the siting presentations given and the Board's discussions was provided to the Board members for further review and analysis prior to the vote on the tentative preferred alternative site selection. Copies of letters from officials and the public concerning the siting decision were either provided to Board members during the ongoing deliberations or were included in the siting summary notebook. The Board members also visited the sites being considered.

The following sub-sections contain summaries of the MWRA's deliberations concerning each criterion as it applied to the site selection to be made. Throughout the process of selecting the tentative preferred alternative site, the MWRA evaluated and compared the information received in light of the criteria adopted. It observed interrelationships among the criteria and discussed the value to be accorded to the criteria in the context of various site alternatives. The last sub-section summarizes the way in which the criteria weighed one against the other with respect to the sites considered.

3.2.1 EFFECT ON NEIGHBORS

The purpose of this criterion was to address treatment facility impacts on the neighbors of the treatment plant. Factors evaluated by the MWRA were traffic, noise, odor, visual effects, property values, and health and safety issues. An exploration of the numbers of persons potentially impacted by the proposed primary, secondary and split treatment plant site options was conducted. Distinctions were made between those who might be voluntarily exposed to the negative impacts and those who resided nearby and had no choice with respect to being impacted, with greater value being accorded to the latter. Consideration was also given to the potential impact of the treatment plant on those working, living or staying at either the hospital on Long Island or the prison on Deer Island. Weight was attached to the fact that persons in the institutions would be closer to the source of impacts for longer continuous periods and would be exposed to a higher degree of impact at any given time. Concern about the effects on these populations served in part to motivate the MWRA to analyze in more detail the "footprints" that could be accommodated on Long Island and on Deer Island and the need for and feasibility of mitigative design concepts, buffers, and/or the relocation of the respective institutions. Also considered was the exposure to impacts over a longer period of time as would be the case for most of the residential neighbors.

Traffic

Traffic access roads were reviewed for capacity and for anticipated peak and average use with and without the utilization of barging and busing. The MWRA learned that the greatest numbers of persons would be affected along the Winthrop access routes, but that a substantial number of persons would be affected along the East Squantum access routes as well. The fewest persons would be affected if the Quincy Shore Drive route to Long Island were available, but there were questions of implementability and structural feasibility that would have to be resolved in order to use that route. The degree of negative impact on the various roads was considered to be roughly the same for the various site alternatives.

A great deal of consideration was given to barging, with the recognition that it was required in order to sufficiently mitigate the traffic impacts that would be caused during construction. Implementability issues with regard to barging -- such as Coast Guard regulations and the construction of piers -- were explored, as were the costs of barging. A determination was made that the same requirements for barging applied to whichever site alternative was selected, and therefore the concerns surrounding barging as a mitigation measure for the alleviation of traffic impacts on neighbors were found to be not site-determinative.

Also reviewed were the potential mitigation measures of ferrying workers to decrease traffic, and rehabilitating or replacing access bridges to accommodate heavy trucking. Implementing each of these measures appeared to pose a relatively similar degree of difficulty between sites and was not found to be an absolute deterrent. The cost of bridge repair or construction did differ between sites and was explored in greater detail by the MWRA in its concern for the issue of traffic impacts and the need to alleviate them. It was determined that it would be most costly to repair, replace or construct new bridges for access to Long Island. Assuming a heavy reliance upon barging and taking into account the above factors, the MWRA

concluded that the traffic impacts were significant but manageable with respect to all sites, and that this was not a site-determinative factor.

Noise

The information on noise contained in the SDEIS/DEIR was reviewed, and the concerns of the Town of Winthrop with respect to the adequacy of that information and the possible site-determinative nature of construction noise impacts were explored. Berms and temporary noise barriers were also discussed. The MWRA received a detailed letter from, and heard a presentation by, Winthrop's technical consultant. It further pursued additional noise information through the technical advisory group meetings and shared the ongoing work done by EPA's technical consultant. An update of this work was presented to MWRA by EPA shortly before MWRA's siting decision. The information on noise gathered and presented by EPA and adopted by MWRA for its tentative preferred alternative site selection indicated that although noise levels at Deer Island would result in greater impact to neighbors, particularly the close neighbors at the House of Correction, the level of construction noise at either site was at acceptable levels or could be sufficiently mitigated so that it was not a site-determinative issue.

Odor

The impact of odors, taking into consideration source, distance, population density, and potential for occurrence, was also evaluated. In addition to evaluating the effect of odors on nearby residences and the existing institutions, the MWRA considered the effect of odors on potential recreational users. It was determined that there might be intermittent effects on neighbors at either site with a potentially substantial effect on recreators at Long Island Head, given the seasonal wind patterns and projected siting plans.

The use of covered tanks to mitigate odors was explored. The MWRA balanced the mitigating effect of covered tanks against the operation and management difficulties that had been experienced at other plants utilizing covers and also considered the additional cost required to employ covered tanks.

After reviewing odors and their potential impact on any of the sites considered, the MWRA determined that odor control was a paramount concern in the design of the treatment plant and that stringent odor controls would be utilized no matter where the treatment plant was located. Having decided this, and having reviewed the odor impact information, the MWRA concluded that odor and its control posed somewhat different problems at each island but balanced out sufficiently so as not to be a site-determinative issue between Long Island and Deer Island.

Odor impacts were found to have some significance, however, in the choice between all secondary options that retained the existing institutions and those secondary options featuring removal of the hospital or House of Correction. The options featuring retention of the existing institutions were considered less desirable because the ability to design the treatment plant with odor sources farther away from residential or recreational uses was substantially reduced at the more constrained sites. The retention of the institutions also increased the number of

persons impacted and degree of severity of impact with respect to the persons living, working or staying in the institutions.

Visual Effects

It was determined that a treatment plant on either island would have a negative impact on persons in the existing institutions due to proximity. With respect to residential neighbors, it was determined that if the institutions remained, there would be a greater negative impact from a treatment plant on Deer Island. If the House of Correction were removed, however, modifying landforms and landscaping could be used to screen the treatment plant from most residences.

Property Values

The effect on property values of the construction and operation of the treatment plant was addressed. Comparisons of affected communities with respect to fair market value, past appreciation, turnover rates and anticipated changes due to treatment plant construction and operation were reviewed. It was generally concluded that, no matter which site option was selected, property values probably would not decline during successful plant operation. However, there was discussion that there may be a decline of property values for communities near the treatment plant during construction but that these values would likely rebound fully after completion of construction. Also discussed was a projected possibility that property values around Deer Island might not fully rebound after construction. However, it was also deemed possible that the substitution of a carefully constructed and well-run treatment plant on Deer Island might raise values in the neighboring communities higher than they would be with the continuation of the existing plant operation. On the whole, property value impacts were determined not to be site-determinative, but a matter to be addressed through mitigation once a site was selected.

Health and Safety

Health and safety concerns of the community -- such as traffic impacts on schools and the elderly, chlorine delivery, air quality reduction from traffic or the facility operation -- were examined and not found to be site-determinative factors.

Summary of Effects on Neighbors

Most of the effects considered within each of the above sub-categories of effects on neighbors were found to be roughly equivalent when applied to the various site options. Although there were perceived imbalances of effects under some of the sub-categories, imbalances against one site under one sub-category tended to be neutralized by imbalances against another site in another sub-category. For example, imbalances found against the use of Long Island for either all secondary or mixed alternatives due to the additional cost of the traffic mitigation measures of repairing or replacing access bridges tended to balance out against the additional cost that might be required for noise mitigation on Deer Island, particularly if the House of Correction was not removed.

Similarly, the imbalance against Long Island caused by the determination that more substantial odor effect was likely on potential recreators was balanced against the possibility for greater negative visual impacts on residential neighbors from a treatment plant on Deer Island if the House of Correction was not removed. In sum, when all the effects were weighed within the sub-categories and the total effects of each sub-category were weighed one against the other, the MWRA concluded that the criterion of effects on neighbors, as a whole, was not site-determinative.

3.2.2 EQUITABLE DISTRIBUTION OF REGIONAL IMPACTS

Equitable distribution of regional impacts was adopted by the MWRA as an additional criterion in response to the issues of fairness raised in the comments on the SDEIS/DEIR. The criterion brought into the decision process considerations of how many and what kind of impacts a community might already bear from proximity to regional facilities other than the contemplated treatment plant. For example, impacts on Winthrop from Logan Airport, the Deer Island House of Correction and the current Deer Island treatment plant were reviewed, as were the effects on Quincy of the existing Nut Island treatment plant and flight patterns from Logan Airport. Distinctions were made between regional uses that provide little benefit to the community impacted (such as Logan Airport vis-a-vis Winthrop) and those regional facilities which daily serve a number of residents of the impacted communities (such as MBTA stations in Quincy). It was further noted that the impact from the latter use was mitigated by the existence of a local-aid fund which provides some monetary reimbursement to host communities.

The consideration of regional use burdens on potentially impacted communities had two applications in the preferred alternative siting decision. First, there was an assessment of whether or not the cumulative regional burdens on any one particular community would be so excessive if the treatment plant were sited nearby as to require, without regard to any other criteria, that the treatment plant be sited elsewhere. One decision-maker concluded that the cumulative and long-term burdens imposed on Winthrop currently and in the past required a decision to site the treatment plant at a location other than Deer Island. Other decision-makers decided that the degree of unfairness did not rise to the level of unilaterally precluding the siting of the treatment plant on Deer Island.

The second way in which the criterion of equitable distribution of regional impacts was applied was to broaden the scope of factors to be considered in assessing effects on neighbors and in determining the nature and degree of mitigation measures to be undertaken. As to the former, the impacts of other regional uses were evaluated not only separately, for their effect on the community, but as they might combine with the noise, odor, and other impacts of the proposed treatment plant.

In assessing the impact of regional facilities on the various communities, the MWRA concluded that the choice of any of the alternative site options was unfair to whichever of the communities were impacted, by virtue of the burdens to be borne by those particular communities on behalf of so many other communities. When contrasting the relative regional burdens between the impacted communities, some decision makers noted that the greatest share of burdens for

regional impacts was already borne by the City of Boston and that Boston's burdens would be increased whichever option was chosen. Between the City of Quincy and the Town of Winthrop, the MWRA concluded that the greater number of regional burdens borne by Winthrop made it more unfair to Winthrop to locate the plant on Deer Island than it was unfair to Quincy to locate the treatment plant on Long Island.

3.2.3 COST

From the outset of its deliberations, the MWRA considered cost to be an important criterion. One of the first tasks the MWRA undertook was to closely examine the previous cost estimates which had been included in the 1982 MDC Site Option Study and the SDEIS/DEIR. Those cost estimates and a new set of estimates prepared by MWRA's consultant were analyzed and discussed both as to the absolute dollar figures presented and as to the relative differences in costs between sites.

Following the initial presentation to and discussion of these figures by the MWRA, consensus was reached by the various cost estimators which reduced the range of difference among them by half. The MWRA reviewed the original figures, the new figures, the basis for each and the rationale for the differences. It recognized that the figures could be firm to only a certain degree, given that a site was being selected prior to any facility design being undertaken. The MWRA chose to consider the higher figures in the range as better representing the most conservative case for design and construction needs and choices, including but not limited to greater assurances of reliability through increased redundancy and mechanical backup.

At each stage of development of the cost figures, the MWRA determined whether the differences changed the ranking or rating of the site alternatives or the relative differences between the alternatives appearing in the SDEIS/DEIR. As to the first two stages of development in cost estimates described above, the MWRA concluded that the ranking or rating of alternatives remained the same and the relative difference between the sites remained constant no matter which estimates at which level of refinement were used.

However, as the deliberations of the MWRA with respect to the other criteria continued, it became evident that cost was closely intertwined with assessments of those criteria and constituted an important factor for each item evaluated. As a result, further discussion and inquiry on costs were undertaken by the MWRA, and a third and more detailed cost analysis was produced. The resulting figures were reviewed and discussed by the MWRA. It was determined that while the new figures narrowed the difference in cost between some of the options involving Long Island and some of the options involving Deer Island, it did not change the ranking of any of the site alternatives.

The MWRA also developed and discussed a comparison of costs between Deer Island and Long Island with and without the existing institutions. The MWRA concluded that in all cases, it was less costly to construct the treatment plant on Deer Island as compared to constructing it on Long Island. It further determined that it was less costly to construct the treatment plant on either of the islands without the respective existing institutions being present.

3.2.4 IMPLEMENTABILITY

The MWRA utilized the implementability criterion to assess how quickly and how predictably the treatment plant could be completed at each of the alternative sites. This included a review of the requirements for and potential impediments to obtaining the real estate necessary for the construction of the treatment plant under the various alternatives. After examining the ownership and the means by which that ownership could be transferred, the MWRA concluded that obtaining the required land under all the options was roughly equal in terms of the legal steps to be taken and the likelihood of success.

The MWRA also reviewed the various permits, licenses and approvals that would be required from federal, state and local authorities in order to build the treatment plant under the various site plans proposed. It found that most of the state and federal permits required were equally applicable to Deer Island and to Long Island. It noted that burial grounds and archaeological/historical properties were a significant issue with respect to Long Island and would probably require extensive mitigation efforts, but also took into account that Deer Island had historic resources that might require consultation with authorities and possible mitigation. Similarly, the MWRA examined the conclusion of the SDEIS/DEIR that the permit issues surrounding burial grounds principally impacted Long Island, but also noted the possibility that they might be involved with Deer Island as well. With regard to the loss of historical or archaeological resources, the MWRA gave weight to the fact that the necessary consultation, mitigation and approval process for whichever island was selected could be engaged in concurrently with the facility planning and design process for the treatment plant, and would not greatly delay the construction of the facility. It was also considered important that this approval process, while requiring consultation and mitigation, could not prohibit the construction of a treatment plant on either island.

Further implementability issues that might apply to only one of the islands, or might be more difficult on one island as compared to the other, were examined. These included wetlands, order of Conditions, bridge construction, barrier beaches, opening of Shirley Gut, air quality questions, possibility of contaminated dredge spoils, existing grit and screenings, hospital relocation and House of Correction relocation. The first three of these issues were thought to have more certain application to Long Island but were considered to have possible application to Deer Island as well. The middle three issues were looked at as possibly raising additional or more difficult issues in the case of Deer Island. Air quality issues were discussed with EPA, and further information obtained by the EPA indicated to the MWRA that the treatment plant could be located at either island without violating national ambient air quality standards for air pollution under the configurations being considered by MWRA and by EPA.

Implementability of relocating the existing institutions on Deer Island and Long Island was scrutinized very closely by the MWRA. The MWRA heard and considered presentations by legal counsel to the City of Quincy and the Town of Winthrop on the need for and comparative legal difficulty of relocating the institutions. The MWRA also received and evaluated communications from the Governor of the Commonwealth, the Mayor of the City of Boston and the Speaker of the Massachusetts House of Representatives. The MWRA concluded that, as to real estate and permit approval issues, the various site options balanced out with respect to implementability. The

removal of the House of Correction from Deer Island, however, was felt by the MWRA to be more feasible than removal of the Long Island Hospital, considering the commitments made by the authorities who would be in a position to implement the respective relocations.

3.2.5 RELIABILITY

The MWRA viewed reliability as the concept of enhancing the overall integrity of the waste treatment system. Information was received on such factors as minimization of detrimental consequences of outages, operational capabilities during and after construction, managerial enhancement and technological reliability. Particular issues of reliability were explored in more detail. The performance of a secondary treatment system was reviewed at some length with stress on the need for proper design to handle such things as variable loads and intake of septage to prevent a malfunctioning of the system which would result in partially treated sewage being released into the harbor through a short outfall. The reliability of tunnels was reviewed, and the use of round versus rectangular clarifiers was discussed. Also considered was the need for backup in the case of catastrophic outages.

With regard to clarifiers, the Board heard that circular clarifiers were considered more reliable by some and that use of those clarifiers would require a greater acreage and expenditure to install, but it also heard that a comparable degree of reliability could be provided by rectangular clarifiers, which use less space and are less costly. The MWRA determined that either type of clarifier could be utilized under the various site options being considered.

The greater or lesser use of tunnels under any particular site option was considered to be an insignificant factor since it was determined that reliability of tunnels could be assured through proper design and maintenance during construction and operation. There was a recognition that those site options with split plants would provide greater reliability in the case of catastrophic outages, but this fact was determined to be offset by the consideration that such outages could be expected to occur at very infrequent intervals and that the ability to achieve reliability at split plants would be more costly because of the need to provide two sets of administration and staffing.

In assessing the various site options in light of reliability factors, the MWRA concluded that, while reliability was a very important consideration in constructing and operating the wastewater treatment plant, it was not a determinative factor in selecting site options between Long Island and Deer Island. Reliability was viewed by the MWRA, however, as a very important factor in its relationship to impact on neighbors. Any reduction of efficiency or increase in operational malfunctions would potentially create greater negative impacts, such as odors, on the neighborhood. It was also recognized and considered an important factor that the capital cost of the secondary treatment plant would be greatly increased by the design and engineering which would be necessary to protect against the greater unreliability inherent in a constrained site. Also, higher operational and maintenance costs would have to be anticipated as a result of the more complex design that would be required.

Weighing all these factors, the MWRA concluded that greater reliability would be obtained in any of the secondary treatment plant options if the respective existing institutions were

removed and, conversely, that reliability would be severely impacted if the secondary treatment plant was built without removing the respective institutions. In any other regard, reliability was considered to be equally obtainable at all site alternatives considered and therefore not site-determinative.

3.2.6 HARBOR ENHANCEMENT

The MWRA's view of harbor enhancement incorporated compatibility of the proposed treatment plant with attainment of the harbor's potential. The MWRA reviewed the site alternatives not only with respect to how each site option might serve as a source of impact on the Harbor but also as to how each option might serve as an opportunity for achieving the objectives listed. This information for the site options -- as they related to one another and to the Harbor as a whole -- was then considered.

Certain concerns of the MWRA were further explored. The potential for recreational use of Deer Island was reevaluated and discussed. As a result, the MWRA accorded greater weight to the recreational potential of Deer Island than had been previously assigned to it in the SDEIS/DEIR. The MWRA concluded that the recreational potential of Deer Island and of Long Island, absent any development, was similar in a number of ways with many of the same types of activities potentially available. Two differences were found to favor the preservation of Long Island's recreational potential, however. The first was the greater potential for public swimming beaches at Long Island. The second was the wilderness experience derived from the wild vegetation in the undeveloped parts of Long Island which, once destroyed, could not be recreated elsewhere.

The two islands were also reviewed for compatibility of recreational use with a treatment plant present. If the existing hospital were retained along with the treatment plant, Long Island would lose the significant recreational potential of Long Island head but might retain its barrier beaches, whereas if the existing House of Correction were retained, Deer Island might be able to encompass a small naturalized park located at Deer Island head. If neither existing institution remained along with the treatment plant, a park at Long Island head and an environmental study area in the southwest of Long Island could possibly be preserved, while at Deer Island, a neighborhood park and a regional park could be created and the natural beaches preserved.

It appeared to the MWRA that the quality of recreation on the islands -- co-existent with a treatment plant but without the existing institutions -- was higher for Deer Island than Long Island. At Deer Island, existing or man-made landforms could screen recreational areas from nearby receptors. At Long Island, the treatment plant would be highly visible, and the wind patterns might carry the odors over Long Island head a significant amount of the time. In balance, the MWRA felt that greater recreational potential for the harbor would be available by building the treatment plant on Deer Island rather than Long Island with or without the existing institutions, but particularly in the latter case.

The MWRA also considered implementability of recreational plans. It was noted that Long Island was physically ready to be developed for recreational use almost immediately if no treatment plant were sited there, but that a much longer time would elapse if recreational use had to wait until a treatment plant was operational on Long Island and the Deer Island treatment plant subsequently removed. The availability of funds for recreational development of Long Island as an already established priority in the Boston Harbor Islands Park system enhanced the likelihood of recreational development of Long Island in the near future.

In assessing the visual effect of the various treatment plant site options, it was determined that the primary and secondary treatment plant options at Long Island were deemed to produce the most radical changes to the natural terrain and to impact the most negatively on the harbor as a whole.

Having reached the above conclusions and having evaluated the information contained in the SDEIS/DEIR, the MWRA concluded that harbor enhancement would be promoted by the preservation of Long Island as a potential park resource and, conversely, that the harbor would be diminished both visually and for recreational purposes, if the treatment plant were constructed on Long Island.

3.2.7 EFFECT ON NATURAL AND CULTURAL RESOURCES

The MWRA examined the natural and cultural resources that would be impacted by each of the site option alternatives. In addition to the information contained in the SDEIS/DEIR, summaries further distilling the information and updated reports of ongoing evaluations of the sites by the Massachusetts Historical Commission were heard and evaluated. The MWRA not only considered the number and significance of historical, cultural and archaeological structures and sites, but also the degree of mitigation that might be required if such places and things were disturbed. The possible effect of any mitigation measures on duration and cost of construction was then assessed. The MWRA also gave some weight to the nomination or intended nomination of those items to the National Register of Historic Places.

The MWRA took into account the number of archaeological sites in existence, the rarity and integrity of such sites, the contribution of such sites to an understanding of our history, and the quantity of material contained in the sites. It was noted that no archaeological sites had been uncovered at Deer Island, but the MWRA also took into account that there had not been as thorough a survey of parts of Deer Island as there had been for the whole of Long Island. Nevertheless, in reviewing the five prehistoric sites uncovered at Long Island, the MWRA determined that their preservation deserved stronger consideration in the choice of a site.

With regard to cemeteries, the MWRA contrasted the existence of several cemeteries on Long Island with the possible existence of a cemetery on Deer Island. Again, however, it noted that Deer Island had not been as intensively surveyed as Long Island. It noted that Long Island in its entirety was being considered for nomination as part of the Boston Harbor Archaeological District. The MWRA concluded that the existence of cemeteries was not as significant as the existence of archaeological sites since the cemeteries could be moved and preserved elsewhere.

Although the movement of graves raised implementation issues, those issues were the same for each island and were not considered to be impossible to overcome.

The MWRA also reviewed the potential eligibility of the Long Island Hospital, the Deer Island House of Correction, and the Deer Island pumping station for listing on the National Register of Historic Places.

Finally, the MWRA reviewed the natural resources of the two islands. While little or no adverse impacts to the natural resources on Deer Island were found, with the exception of the removal of the drumlin on Deer Island in the case of a secondary treatment plant being sited there, it was determined that the wetlands and barrier beach at Long Island might be adversely affected by the construction of either a primary or secondary treatment plant even if strict controls were imposed. Concern was expressed that even a split secondary option would impact on sensitive areas on Long Island. In sum, the MWRA concluded that the least negative impact on natural resources would be achieved by selecting Deer Island for an all-secondary or all-primary wastewater treatment plant.

3.2.8 MITIGATION MEASURES

The MWRA used the criterion of mitigation measures to focus on and clearly consider those actions which might be or ought to be taken with regard to a particular site to make that siting choice environmentally acceptable, and to assure to the greatest extent feasible that negative impacts from the siting selection would be alleviated or compensated for. The MWRA considered both environmental and non-environmental measures.

Environmental Mitigation

Environmental mitigation measures were considered to be those steps which would minimize adverse impacts from the construction and operation of the treatment plant.

Construction impact mitigation measures reviewed included barging, land modifications and buffers, scheduling and specifications for equipment to reduce noise impact, and monitoring and response mechanisms to oversee and enforce construction mitigation efforts.

Operations impact mitigation measures examined included the use of technology, design and buffers to reduce noise, odors and visual impacts on residences, institutions and/or recreators, as well as adaptation of site layouts and monitoring mechanisms to ensure proper operation and maintenance of the treatment plant and to assure responsiveness to changing conditions.

Most of the environmental mitigation measures were explored not only separately but as part of discussions involving reliability, effect on neighbors, cost, site layouts and effect on natural and cultural resources and are addressed to varying degrees under each of those topics in the FEIR. The MWRA articulated throughout these discussions a strong commitment to environmental mitigation, particularly as it would reduce negative impacts on the nearby receptors. It also recognized, however, that the extent of the mitigation employed would be

determined, in part, by balancing the cost to the ratepayers against the degree of mitigation to be achieved. In some cases a determination was made that certain amounts or kinds of mitigation would be undertaken regardless of cost. For example, it was decided that stringent odor controls would be employed no matter where the treatment plant was constructed. It was also determined that a significant degree of barging was required for the transportation of construction equipment and materials.

Most of the environmental impact measures considered were deemed applicable in some degree to all sites, but some measures were found to be required more frequently or to a greater degree under one site option or another. For example, the environmental mitigation measures to be employed when disturbing cultural or natural resources were perceived to be required more often and to entail more effort at Long Island than at Deer Island due to the greater number and value of sites located at Long Island. Balanced against this was the greater impact of noise on Deer Island neighbors and the resulting need for additional mitigative measures. The MWRA concluded that the individual environmental mitigation measures or the degree to which those measures might need to be applied differed from site option to site option but that, when all the mitigation measures for a particular site were totaled and balanced against all the mitigation measures required for another site selection, the environmental mitigation measures tended with one exception to balance out and not to be site-determinative. The exception pertained to the split plant options which would require the implementation of mitigation measures at two sites instead of one, with a substantial increase in cost. The MWRA considered this a factor to be weighed against selection of the split plant options.

The MWRA did decide that mitigation measures, while not being site-determinative between all Deer Island and all Long Island, were of critical importance with respect to whichever site it chose. Consequently, MWRA voted just prior to selecting its tentative preferred alternative site, that its FEIR for siting the Harbor Islands treatment plant should include a complete discussion of all practicable means and measures to minimize damage to the environment in connection with construction of the new sewage treatment facility including but not limited to (i) barging of construction material and personnel, (ii) limitations on unnecessary construction period traffic, (iii) controls on construction noise, (iv) controls on operating noise and odors, (v) visual enhancements of the site, (vi) alternatives to through-neighborhood trucking of chlorine for purposes of facility operations, (vii) construction of deep ocean outfalls, and (viii) development of compatible recreational uses on the site and elsewhere in Boston Harbor. The Board also voted on the day it made its tentative preferred alternative selection that it preferred that sludge management facilities be located off-site from the treatment facility.

Non-Environmental Mitigation

The MWRA considered non-environmental mitigation to be an important consideration in the siting decision and a necessary adjunct to the construction of a treatment plant of the size and complexity planned. Non-environmental mitigation measures examined were the opening of Shirley Gut, which would physically isolate Deer Island from the mainland, rehabilitating or reconstructing access bridges, development of recreational or other multi-use possibilities for the sites considered, protection against future facility overload, assurances of plant operating performance, employment of innovative technology, and relocation of the existing

institutions. With respect to the measures reviewed, the ones determined to be site-specific were those concerning access bridges, opening of Shirley Gut, and relocation of the existing institutions.

As discussed in the text regarding the criterion of effect on neighbors, the MWRA evaluated the comparative difficulty and cost regarding rehabilitation or replacement of access bridges and determined that it would be more costly to repair, replace or construct new bridges for access to Long Island.

After examination of the geologic processes and currents affecting Shirley Gut, the need for and high cost of maintenance to keep the Gut cleared, the numbers of regulatory requirements for undertaking such a project and the possibility that its being opened would result in greater nearshore pollution and perhaps permit movement of polluted waters from Boston Harbor through the gut to the eastern shores of Point Shirley and Winthrop, the MWRA determined that the opening of Shirley Gut was not a feasible mitigation measure and that other means of separating Deer Island from the mainland should be considered if a need for separation were determined necessary or desirable.

The relocation of the existing institutions was determined by the MWRA to be a critical non-environmental mitigation measure. This conclusion resulted from the MWRA's evaluation of: the effects of noise, odor and visual aspects of the treatment plant on the persons working in or inhabiting the institutions; the reduction in reliability which would result from construction of the treatment plant on sites constrained by the presence of the institutions; the far greater construction cost and ongoing maintenance and operational costs which would result from having to construct the treatment plant on a constrained site; and the greater recreational potential which would be available for the harbor if the institutions were removed. With respect to cost, recreational potential and the effects of noise, the MWRA concluded that it was even more important to relocate the House of Correction than the Long Island hospital, since the negative impact from retaining the existing institution on the same site as the treatment plant was greater for Deer Island than for Long Island. The MWRA also determined that while regional impacts would be more equitably distributed by the relocation of either institution, more equitable distribution would result from the relocation of the House of Correction due to the nature of the respective institutions and the number and kinds of regional impacts already experienced by the Town of Winthrop. The MWRA further noted that property values were more likely to be increased in the Town of Winthrop by the removal of the House of Correction than those in the City of Quincy by the removal of the hospital, and that the health and safety of residents of the Town of Winthrop were apt to benefit by the relocation of the House of Correction.

In sum, the MWRA concluded that if either Long Island or Deer Island were selected, the existing institutions should be relocated. As between the two islands, the MWRA decided that it was more important and more beneficial to remove the House of Correction if Deer Island were selected than it was to relocate the hospital if Long Island were selected. Some decision makers felt that if Deer Island were selected, the House of Correction must be relocated. For these decision makers, the relocation of the House of Correction was not a mitigation matter but an action compelled by the other criteria.

In evaluating the removal of the institutions, the MWRA placed strong emphasis on the implementability of such a measure. It received and considered commitments made by those authorities empowered to and responsible for any such relocation and determined that the implementability of relocating Deer Island House of Correction was extremely likely -- far more likely than relocating the hospital.

As with environmental mitigation, the MWRA indicated its strong commitment to non-environmental mitigation by voting for the preparation of a complete discussion, for use by the Board of Directors, of proposed non-environmental mitigation measures for the construction of the Harbor Islands treatment plant including, but not limited to, construction workforce hiring preferences for residents of impacted communities, protection against diminished real estate values from nearby construction activities, preferential economic considerations for impacted communities, and funding for repair of bridges, roads or other physical infrastructure damaged by construction activities.

3.2.9 CRITERIA WEIGHING PROCESS

The MWRA concluded that while all the criteria were important, some criteria were of relative equivalent value when applied to the various site options and were not site-determinative. Those criteria were: reliability, effects on neighbors, and implementability, as well as the environmental mitigation part of mitigation measures.

The five criteria which the MWRA concluded were site-determinative were: cost, equitable distribution of regional impacts, harbor enhancement, effect on natural and cultural resources, and non-environmental mitigation. All the site-determinative criteria except equitable distribution of regional impacts weighed in favor of selecting Deer Island as the site for the wastewater treatment plant. While the considerations of fairness implicit in the equitable distribution of regional impacts were valued very highly by the MWRA, they were not sufficient, by themselves, to outweigh the considerations of cost, harbor enhancement, effect on natural and cultural resources, and non-environmental mitigation measures.

In addition to determining which island should be the site for the construction of the Harbor Islands wastewater treatment plant, the MWRA concluded that whichever island was chosen, any existing institutions on that island should be removed. It based that conclusion on the results of applying the criteria of reliability, cost, harbor enhancement, effects on neighbors, and mitigation measures. Furthermore, the MWRA found on the basis of cost, equitable distribution of regional impacts, effects on neighbors (health and safety)*, harbor enhancement, implementability, and mitigation measures (non-environmental) that Deer Island without the House of Correction was the best site configuration considered. For some decision-makers, these latter criteria compelled the conclusion that if Deer Island were to be chosen as the site for the treatment plant, the House of Correction had to be removed.

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* While health and safety issues originating from the construction and operation of a wastewater treatment plant were found not to be site-determinative, health and safety were considered to be enhanced by the removal of the House of Correction.

3.2.10 TENTATIVE SELECTION

On July 9, 1985, on the day prior to its selection of a preferred alternative site, the MWRA voted its determination that the cost of a new wastewater treatment facility would be enhanced if the facility could be constructed on a site unrestricted by another existing institution, and that the removal of any existing conflicting institution would effectively serve to mitigate the impact of the location of a new wastewater treatment facility on surrounding communities.

In addition, the MWRA voted to direct its staff to work with any and all elected or appointed officials for the purpose of expediting the removal and relocation of any other institution located on whichever island it ultimately designated as the preferred alternative site for the new wastewater treatment facility. It further instructed its interim Executive Director to take certain actions to implement its position.

On July 10, 1985, the Board of Directors of the Massachusetts Water Resources Authority, in two separate votes, each ten to one, designated Deer Island as its preferred alternative for the siting of a new primary treatment wastewater treatment facility and as its preferred alternative for the siting of a new secondary treatment wastewater facility for Boston Harbor. The designations were explicitly undertaken for the purpose of completing final environmental and other precommencement review and to serve as the basis for undertaking only such additional work in the nature of planning, design, site assembly and any other work as can be accomplished prior to the availability of the Final Environmental Impact Report.

3.2.11 FINAL SELECTION

The following is the text of G.L.C. 30 Section 61, Findings by the MWRA on the Selection of Deer Island as the Site for Wastewater Treatment Facilities in Boston Harbor.

> On February 3, 1986, the MWRA made its final selection of a site for the proposed harbor island wastewater treatment plant. The selection of Deer Island as the location for the new facility brought to a close eight years of evaluation, discussion, comment and refinement of siting issues. Most of the history of the process followed and information explored is contained in the Supplemental Draft Environmental Impact Statement/Draft Environmental Impact Report (SDEIS/DEIR) and the MWRA's Final Environmental Impact Report on the Siting of Wastewater Treatment Facilities in Boston Harbor (FEIR).
>
> In particular, the latter document details the decision process engaged in by the MWRA from its inception in early 1985 through to its tentative selection of Deer Island as the site for the wastewater treatment facilities in July, 1985. Since July, the MWRA has continued to gather information which it has published in the FEIR, has received and evaluated comments to the FEIR including the Secretary's Certificate of Adequacy, and has reviewed EPA's Final Environmental Impact Statement and comments submitted on that document. Based on this information and on its previous examinations and evaluation, the MWRA has made its final selection. The following sets forth the findings upon which that final site selection rests and the process by which it was completed.

DECISION PROCESS

In addition to its prior deliberations leading to the tentative selection of Deer Island as a site for the harbor island treatment plant, the MWRA evaluated two new categories of information in making its final siting selection. The first, technical information collected or refined between the July 1985, decision and the publication of the FEIR, was presented to and discussed by the MWRA Board of Directors at a series of public board meetings held throughout the fall of 1985. During these meetings, the MWRA reviewed and approved the content of the FEIR and adopted commitments to major mitigation measures contained in that document.

The second category of information reviewed by the MWRA was public and official comment to the FEIR, including the Certificate of Adequacy issued by the Secretary of the Executive Office of Environmental Affairs. In addition, the MWRA staff reviewed the Environmental Impact Statement issued by the Environmental Protection Agency and the Board of Directors reviewed the comments to that document as well as a summary of relevant distinctions between the FEIS and FEIR.

The information thus gathered was then evaluated for its applicability to the method of decision-making to be used in the final selection, for the effect of the information on the application of decision criteria to site options and for its effect on the mitigation measures to be adopted by the MWRA. A summary of that evaluation follows.

DECISION-MAKING METHOD

Selection of Criteria

The MWRA chose to maintain the eight criteria utilized in its tentative site selection process: Reliability, implementability, harbor enhancement, impacts on cultural and natural resources, costs, effects on neighbors, mitigation and equitable distribution of regional responsibilities. These criteria had been selected originally by the MWRA in response to the decision process carried out through the SDEIS/DEIR and the comments on that process. The Secretary of Environmental Affairs ("Secretary"), in his Certificate of Adequacy on the FEIR ("Certificate") approved the use of Equitable Distribution of Regional Responsibility as a means of assessing the more emotional, unquantifiable aspects of siting but opined that mitigation was better addressed only after a siting selection and not as a part of the siting decision process. As to the latter, the MWRA found that the use of mitigation as a criterion in arriving at a site selection had served a useful purpose and had contributed a focus different from the discussion of mitigation after a site was selected and that it was better to continue the decision process as already begun rather than making a major shift in the use of criteria at the culminating point in the decision process.

Weighing of Criteria

The Secretary's Certificate on the FEIR had recommended that each criterion be assigned a relative importance in the final decision. The MWRA reviewed the eight criteria selected and determined that they should be given equal weight as compared to each other.

Site Options

The MWRA, in reviewing the information gathered in light of the criteria utilized, found that a number of earlier determinations made in its tentative decision process should remain intact. Some of these determinations, once confirmed, served to eliminate certain site alternatives from consideration. For example, the MWRA confirmed its earlier tentative site decision that Nut Island was unacceptable for the construction of a treatment plant of the size contemplated, particularly with the filling of Quincy Bay which would be required. The Secretary's Certificate had acknowledged and found this conclusion to be acceptable, and other comments had only served to support this position.

The MWRA also confirmed its tentative decision that the four split plant options be rejected on the grounds that only the criteria of reliability and equitable distribution of regional impacts favored the selection of any of the split plant options, while the concerns encompassed in the remaining criteria were adversely affected by those alternatives. For example, the split island options would be more costly to construct, operate and maintain; would cause aggravated impacts to a wider universe of neighbors -- thus causing the need for greater mitigation; would be more difficult to implement because of the need to obtain approximately twice as many permits; and did not significantly lessen the impact of single island alternatives on cultural or natural resources or harbor enhancement. There was no additional or different information presented to persuade the MWRA to change this position.

As a result of these findings concerning site alternatives, the MWRA was left with a comparison of all Long Island and all Deer Island as possible sites for the harbor facility. A summary of the analysis of these two site alternatives in light of each of the criteria used and the information gathered as it affected those criteria, and the conclusions reached, follows.

APPLICATION OF DECISION CRITERIA TO THE ALL LONG ISLAND AND ALL DEER ISLAND SITE ALTERNATIVES

CRITERIA WITH NO SITE DETERMINATIVE EFFECT

In examining Long Island and Deer Island in light of the eight criteria, the MWRA found two criteria, reliability and effects on neighbors, to be of relatively equivalent value and therefore not to be site determinative.

Reliability

The MWRA had previously found reliability to be non-site determinative in its tentative decision because the size and configuration of each of the islands presented the same potential for use of design and layout to provide for reliability of the waste treatment system. The MWRA, in its current evaluation on reliability, noted that no new information had been presented to change that determination and confirmed its earlier decision.

Effects on Neighbors

The MWRA also found the effects on neighbors to be roughly equivalent between the two islands. As before, effects on neighbors were reviewed in six components: traffic impacts, noise impacts; odor impacts; visual impacts; property value impacts and safety impacts.

Traffic

Following its initial determination that the traffic impacts were comparable between the two sites, the MWRA commissioned a study to augment information provided in the SDEIS/DEIR traffic analysis. This analysis examined roadway conditions, assembled traffic counts, determined the present level of service on the roadways (LOS), and evaluated the impact of expected construction traffic. The MWRA concluded that for the predicted level of construction related traffic there was sufficient roadway capacity leading to each site during peak hours and that the impact although somewhat worse at some intersections for access to Long Island, was relatively comparable.

The MWRA also further explored the feasibility of barging, identifying the types of barging and/or water transportation that might be needed and sites that could be utilized. The MWRA made commitments to a level of barging, to caps on construction-related traffic and to busing of workers, all of which is set out in the Commitments to Mitigation section below.

The MWRA reviewed traffic-related comments received on the FEIR. The MWRA concluded, based on its original evaluation and the additional traffic information and comments collected since its tentative decision and its strong commitment to mitigation measures, that the traffic impacts remained roughly equal and did not favor either island.

Noise

The MWRA, in its tentative decision, adopted the then current position of EPA that noise levels at Deer Island would result in greater impact to neighbors, particularly the close neighbors at the House of Correction. However, that position was predicated on EPA's view that Long Island as a site for the treatment plant could not contain the Long Island hospital whereas the Deer Island site could encompass the House of Correction.

The MWRA in its final selection compared the sites equally, i.e. both sites with existing

institutions and both sites without those institutions. The MWRA concluded that when the sites without institutions were compared, there was more noise impact on neighbors at Deer Island than at Long Island. If the sites were compared with the institutions present, then the severity of impact on the residents or workers at each institution was equivalent.

To explore whether noise levels at Deer Island could be kept at acceptable levels, the MWRA retained an acoustical consultant to evaluate expected noise levels during both construction and plant operation for the Deer Island site. The consultant also furnished information to the Board on existing acoustical conditions, applicable regulations and an evaluation of the expected effectiveness of noise mitigation measures.

The MWRA concluded that for the nearest residence the noise levels from both construction and operation were within applicable legal standards. Furthermore, during the daytime the projected noise would be indistinguishable as compared to the existing ambient levels. At night, with a minimum of construction to be anticipated, nighttime noise would not be an impact. During plant operation, if power was generated on-site, a slight increase in background levels over existing levels was determined to be likely.

Based on this information and upon review and assessment of comments on noise, the MWRA concluded that while noise impacts upon receptors other than the current institutions would be greater at Deer Island, those impacts could be maintained at acceptable levels. The MWRA also found that the noise impacts at Deer Island prison or Long Island Hospital, because of the proximity of those institutions, would raise the noise levels above the legal standard and would require extraordinary mitigation measures to be adopted.

Odor

Odor studies conducted on behalf of the EPA have indicated that potential odor impacts on neighbors are comparable, regardless of plant location. This confirmed the MWRA's tentative decision that the issue of odor was not site determinative. The MWRA further recognized that odor control was a paramount concern and that stringent odor controls would be utilized no matter where the treatment plant was located. As a result of further work presented since its tentative selection, the MWRA concluded that control stystems such as wet scrubbers and carbon absorption columns would likely be effective in controlling the odors. The MWRA confirmed its tentative decision that odor impacts were not site determinative and committed itself to a limit of no detectable odor off-site as well as a goal of no objectionable odor on-site.

Property Values

Reviewing trends in real estate values and the impacts of other noxious facilities on property values, the MWRA confirmed its tentative decision that the effect on property values, to the extent that that effect could be predicted, was not site-determinative.

Visual Impacts

In its tentative decision the MWRA determined that a treatment plant on either island have a negative impact on persons in the existing institutions due to proximity. With respect to residential neighbors, it was determined that if the institutions remained, there would be a somewhat greater negative impact from a treatment plant on Deer Island. If the House of Correction were removed, however, modifying land forms and landscaping could be used to screen the treatment plant from most residences.

Health and Safety

Health and safety concerns of the community -- such as traffic impacts on schools and the elderly, chlorine delivery, air quality reduction from traffic or the facility operation -- were examined and found once again not to be site-determinative factors.

Summary of the Effects on Neighbors

Most of the effects considered within each of the subcategories of effects on neighbors were found to be roughly equivalent between Long Island and Deer Island. For those two categories in which a somewhat more negative impact was discerned for Deer Island, noise and visual impact, the degree of difference in impact was not sufficient to change the balance of effects on neighbors between the two sites.

SITE DETERMINATIVE CRITERIA

The MWRA found the remaining six criteria to have a site-determinative effect. Five of the criteria favored the selection of Deer Island while one criterion, equitable distribution of regional responsibilities, favored the selection of Long Island. A summary of that analysis follows.

Equitable Distribution of Regional Responsibility

Just as in its tentative decision, the MWRA found in its final site selection that this criterion favored the selection of Long Island over Deer Island. The impacts of other regional uses such as Logan Airport, Deer Island House of Correction and the current Deer Island treatment plant were found to have greater impact on Deer Island neighbors than the airport and other regional facilities had on Long Island neighbors. The MWRA concluded that it was more unfair to site the harbor facility at Deer Island.

Cost

The MWRA again found this criterion to favor selection of Deer Island. There was no change to the cost information upon which the MWRA had made its tentative decision. Those figures still showed the construction of a treatment plant on Deer Island to be less costly than a facility at Long Island. While noting that EPA had found this criterion to

be non-site determinative and that the Town of Winthrop had concurred with this conclusion, the MWRA recognized that this reflected a value judgment by the EPA and Winthrop of the relative unimportance of the dollar difference which both EPA and MWRA agreed existed rather than different information as to the cost figures themselves. The MWRA, as the operator of the system felt that the difference in cost between the two sites was of site significant importance.

Implementability

In its tentative decision, the MWRA found implementability to be non-site determinative. The information which the MWRA had reviewed at that time covered the permitting and land acquisition issues and, based on the assessment that the numbers and types and timing considerations of permits and approvals were generally the same, had concluded that the criterion was relatively equivalent between the sites. The MWRA also noted at that time that the removal of the House of Correction from Deer Island was far more implementable than the removal of the hospital from Long Island due to the expressed support for the former by those in a position to effect the removal.

Two factors have been added to the implementability discussion since the tentative decision, however, which have caused the MWRA to change its conclusion about this criterion. The first is the concurrence in the approval by the Secretary of the selection of Deer Island as the site for the treatment plant. The second is the selection of Deer Island by the EPA as its preferred alternative. The choice of Deer Island as the preferred site by both a state regulator and a federal regulator, each of which has responsibilities in further permitting or approvals concerning the construction and operation of the treatment plant and related facilities, increased the likelihood of successful and expeditious processing of the many regulatory reviews and permits pertaining to the Deer Island site. It also suggests a facilitating of the disposition of federal land located on Deer Island. In light of these factors, the MWRA has found in its final siting decision that implementability is no longer non-site determinative and that it weighs in favor of selecting Deer Island.

Harbor Enhancement

A further exploration into recreational potential of Deer Island conducted during the tentative decision process was completed for the FEIR and confirmed what had already been suggested during the tentative decision process: that a greater potential existed for Deer Island than had been suggested in the SDEIS/DEIR. However, the possibility of this greater potential had been discussed when the MWRA made its tentative selection and its confirmation did not change the MWRA's determination that harbor/enhancement favored siting the treatment plant at Deer Island. The MWRA still found that Long Island's recreational resources included natural and undeveloped aspects which could not be recreated if lost; that Long Island as a park could be brought to reality sooner since it did not have sited on it both a prison and a current treatment plant which had to continue operating until the new plant was on line; that there were indications that official support and dollars had already been or could readily be mobilized to make a park on Long

Island a reality; and, finally, that the adverse visual impact on the harbor was greater from a treatment plant on Long Island because of the Island's position in the harbor and its configuration.

Effect on Natural and Cultural Resources

In examining the natural and cultural resources of each island, the MWRA took into consideration additional pieces of information received since its tentative decision. In particular, the MWRA considered the results of a study, which it had commissioned, of parts of Deer Island which had never been adequately evaluated before for the existence of archaeological or historical resources. That study confirmed the existence of a cementery in the northeastern part of the island and also confirmed the potential eligibility of the Deer Island pump station and portions of the Deer Island House of Correction complex for nomination to the National Register. Subsequently, the Massachusetts Historical Commission found that the pump station, and two buildings in the prison complex met National Register criteria. In its comments on the FEIS, the Commission also noted that Long Island in its entirety had been nominated to the National Register as a component of the Boston Harbor Islands Archaeological District, that the Long Island hospital complex also met National Register criteria of eligibility and that historic burial grounds existed on Long Island.

All the information received concerning these resources was a confirmation of material already considered to be potentially true during the MWRA's tentative decision. The MWRA found, as it had in its tentative selection, that Long Island possessed more resources and more unique resources than Deer Island and that these resources, particularly the unique resources, would be adversely impacted by the siting of the harbor treatment plant facility on Long Island.

The MWRA noted that EPA had found this criterion to be non-site determinative but recognized that EPA had hypothesized layouts which could avoid these resources without fully exploring the technical feasibility of those layouts. The MWRA had assured that the layouts upon which their conclusions rested were technically feasible.

Mitigation

The MWRA utilized the criterion of mitigation to focus on and clearly consider those actions which might be or ought to be taken with regard to a particular site to make it more acceptable. The utilization of this criterion in the siting decision process brought to the fore and highlighted mitigation measures which might be site specific and permitted the MWRA to weigh the need for those measures in its siting selection. Early analysis of mitigation needs during the decision process also laid the groundwork for a thorough understanding and appreciation of mitigation measures to be adopted once a site was chosen. The mitigation measures to which the MWRA finally committed itself in the implementation of its site selection of Deer Island are contained in the Commitments to Mitigation section which follows.

With respect to the effect of the mitigation criterion in the siting selection process, the MWRA confirmed its earlier finding that mitigation favored the selection of Deer Island.

While various measures to mitigate construction and operation impacts such as noise and odor or the destruction of natural or cultural resources might shift the balance slightly toward one site or the other within each of those categories, the total number of kinds and degree of mitigation required for one site or the other tended, with one exception, to balance out roughly equal as a whole. The one exception was the mitigation measure of relocating the existing institutions. The MWRA found in its tentative decision and confirmed in its final decision that it was critical to relocate whichever existing institution was located on the chosen site due to the adverse environmental effects which accrued from constructing the treatment plant on a constrained site in close proximity to the particular institution. However, the MWRA also found that there was more net benefit to building the treatment plant on Deer Island and removing the House of Correction than building on Long Island and removing the Long Island Hospital since removal of the House of Correction would favorably affect property values and the safety of the currounding community and would promote equitable distribution of regional facilities. Further details as to the findings of the MWRA regarding the removal of the existing institutions and the Deer Island House of Correction in particular is contained in the Commitments to Mitigation section which follows.

Final Siting Decision

Having found two criteria effectively neutral between Long Island and Deer Island (Reliability and Effects on Neighbors), one criterion favoring the selection of Long Island (Equitable Distribution of Regional Responsibility) and five criteria favoring selection of Deer Island (Cost, Implementability, Harbor Enhancement, Effects on Natural and Cultural Resources and Mitigation), and having given each criterion equal weight, the MWRA determined that the most appropriate site for the harbor island wastewater treatment facility is Deer Island.

COMMITMENTS TO MITIGATION

Recongizing the need to adopt all feasible measures to mitigate the adverse environmental impacts, the MWRA, as part of the FEIR, set forth a series of mitigation commitments designed to alleviate the impacts associated with the construction and operation of the Harbor Islands plant. During the process of making its final siting decision the MWRA reviewed the public comments on the proposed mitigation commitments and the comments received from the Secretary of Environmental Affairs and adopted a final series of mitigation commitments. This section sets out those commitments.

--Commitments on Flow and Growth
--Commitments on Plant Maintenance
--Commitments on Odor Control

--Commitments on Noise
--Commitments on Barging
--Commitments on the Use of Liquid Chlorine
--Commitments on the Relocation of the Deer Island House of Correction

Commitments on Flow and Growth

Recognizing the need for responsible management and being sensitive to the possible need for expansion of the proposed Harbor Islands treatment plant, the MWRA has made the following commitments with respect to flow and growth:

- The MWRA will undertake all necessary and prudent planning and management initiatives to avoid overloading the Harbor Islands treatment plant.

- The MWRA will not expand the treatment plant capacity unless or until it has implemented flow management techniques and has developed and implemented a program to avoid excess pollutant loading. These techniques and programs include:

    - Conducting infiltration/inflow reduction programs

    - Instituting water conservation programs that can reduce wastewater flows

    - Pricing of water and sewer services to promote the conservation of water, thus reducing wastewater flows

    - Controlling pollutant loads through pricing strategies and pretreatment programs

    - Controlling both flow and loads through regulatory controls, such as flow reduction programs to compensate for new connections

    - The MWRA will develop monitoring and triggering programs so that it will be able to test the effectiveness of the flow management techniques and to provide the MWRA with the ability to determine when planning for the MWRA's next increment of treatment capacity should be undertaken

- If the MWRA determines, through its monitoring and triggering programs, that the flows and loading are increasing at rates higher than projected in the FEIR, it will take all necessary steps to plan, design, and construct ancillary facilities including (but not limited to):

    - Flow control structures, such as on-line and off-line storage to minimize peak flows at the plant

    - Septage treatment facilities to reduce pollutant loadings on the Harbor Islands plant

- o If the ancillary facilities are insufficient to accommodate increased flow and loading and to prevent exceeding the design capacity of the Harbor Islands treatment plant, the MWRA will take all necessary steps to plan, design, and construct satellite treatment plants unless it determines it would be economically or environmentally infeasible to do so.

- o Notwithstanding the foregoing, the MWRA does not intend the adoption of the above commitments to require the postponement or cancellation of any capital program contained in the Authority's Fiscal Year 1986-88 capital budget that services to eliminate an existing problem of sewage backups.

The purpose of these commitments is to confirm the MWRA's desire to establish a sound and rational program for assessing future capacity needs, to respond to public concerns on overloading and future system expansion, and to provide a framework within which additional capacity will be planned.

Commitments to Operation and Maintenance

MWRA has already made clear its commitment to improved operations and maintenance by approving both a substantially increased operating budget and by authorizing significant increases in operations and maintenance staff for existing facilities. MWRA's commitment to maintenance is underscored by their adoption of the following assurances:

- o Review of Recurrent Budgets. Annual operating budgets will be carefully scrutinized to be certain that these budgets reflect not only a sound maintenance program for existing facilities but that the budgets reflect any new facilities expected to be in service during the budget year. The MWRA will link budget expenditures with performance indicators that reflect the efficiency and effectiveness of the maintenance programs.

- o Renewal/Replacement Expenditures. More than $100 million in construction projects have been initiated at the Nut Island and Deer Island treatment plants to replace much of the antiquated equipment at these plants. These upgraded programs are expected to be completed in 1989 and will contribute significantly to the reliability of the existing plant equipment. Capital budgets in future years will continue to reflect the important role that R/R plays in the maintenance of treatment facilities. The MWRA's maintenance procedures will be modified at an early date to incorporate record keeping procedures that will provide a rational basis for R/R investment in future years.

- o Review of Maintenance Procedures. Prior to the completion of the on-going upgrade program, the MWRA will initiate a review of its existing maintenance procedures. Strengthened maintenance procedures will be designed including an aggressive housekeeping and preventive maintenance program. These procedures will be amended as new treatment facilities are constructed.

- Initiate Early Planning. To ensure that operations and maintenance considerations are included as an integral part of the planning for all new facilities, MWRA will require that the plant's facilities plan include a preliminary plan of operations. The preliminary plan of operations will identify the additional or unique O & M requirements of the recommended facilities, including staffing and special training needs, manuals, special tools and workshops, and estimated budget considerations. This preliminary plan of operations will provide MWRA with two to four years' lead time prior to completion of facilities to incorporate the maintenance requirements of new facilities into on-going maintenance programs.

- Adoption of Performance Indicators. MWRA will adopt performance indicators into the agency's proposed management information systems that will permit the Authority to review on a regular basis the level-of-effort and the performance of the maintenance activities. Indicators such as plant performance, equipment availability, maintenance labor/expenditures, custodial inspection reports, spare parts inventory, and equipment age will be monitored to regularly examine the efficiency of the maintenance efforts. Additionally, the Authority will involve the community in reviewing maintenance programs to provide focus on issues of local importance.

Commitments on Odor Control

The MWRA commits to the construction of the treatment pant that will control odors so as to eliminate detectable odors off-site and to control odors as necessary to protect the public health. Furthermore, the MWRA commits to the control of odors so as to minimize, to the maximum extent feasible, objectionable odors on-site.

The type of odor control needed will be selected during the facility planning effort. Sampling of the odor potential characteristics of the influent wastewater will be conducted as part of the facilities planning to provide the necessary data to develop a program of source control and to size and select the odor control equipment.

The most reliable means of measuring odor performances is the human nose. In order to measure the plant odor performance, an odor panel will be created composed of individuals from the community as well as individuals from the MWRA. The panel will routinely monitor for odors to ensure that no objectionable odors are occurring off-site. The panel will also respond to odor complaints received by the plant, by assisting in the investigation of the odor and recommending odor control techniques.

Commitments on Noise Control

The MWRA is committed to complying with all the legal standards of both City of Boston noise control ordinance and the Department of Environmental Quality Engineering.

Because of the scale of the proposed plant, however, the MWRA is setting as a goal noise abatement that goes beyond simply adhering to the City of Boston code. The MWRA has

to define, by the FEIR, what noise levels may be achievable and will examine means of noise abatement throughout the planning, design and operation of the facility.

The MWRA further commits to the development of a program for avoiding adverse noise impacts, the components of which shall be resolved during facilities planning but which shall include the following:

- The establishment of an Acoustical Review Board. The Acoustical Review Board will include representatives from the community as well as engineers and MWRA staff.

- The use of available and feasible noise control techniques, which may include items such as the evaluation of the acoustical characteristics of operational equipment and flexible scheduling of construction activities to minimize noise.

- The establishment of necessary training and hiring practices to assume the best possible control of noise impacts.

- The involvement of the community in the development of noise control programs and the participation of community representatives in those programs.

Commitment on Barging and Busing

The determination that barging and busing are necessary is a direct consequence of the volume of traffic associated with the construction of the proposed facility and the limited capacity of roadways leading to the plant site. The Traffic section of the FEIR describes the capacity of the roadways. The commitment to barging, therefore, also requires a commitment to maximum traffic levels associated with the construction of the plant. Those traffic levels are defined for both the pier construction period and for the period thereafter.

Prior to construction of the piers, it is not feasible to barge materials to the site. Therefore, the MWRA has given a high priority to the identification of barge sites, design of pier facilities and construction of those piers. The Authority is engaged in the selection of a consultant for the necessary barge and pier facilities. The MWRA commits to limiting the trucking of materials for construction of the piers to a maximum of 20 trucks per day.

Upon completion of the pier facilities, the barging of almost all heavy construction equipment and materials is, based on the analyses conducted to date, an achievable level of barging. The level of commitment is conditioned, however, to allow for contingencies that may result from scheduling or operational problems. The extent of such contingency trucking, after the completion of the piers, will be limited to a service fleet of eight trucks. Also, in order to minimize impacts associated with commuting of construction workers to the plant site, the Authority has committed to the busing of all workers, using a maximum of 28 buses per day.

In addition, the Authority will undertake an evaluation of the practicality of providing ferries to transport construction workers to the job site.

Commitments on the Trucking of Liquid Chlorine

The MWRA has committed to cease the trucking of liquid chlorine through the streets of Winthrop as soon as possible when water access facilities become operable and the transport of alternate disinfectant or barging of liquid chlorine becomes feasible.

Commitment on Relocation of the Deer Island House of Correction

The MWRA has determined that the Deer Island House of Correction must be relocated from Deer Island by those parties with jurisdiction over its operation and that such relocation must be deemed a mandatory mitigation measure.

The MWRA's conclusion with respect to this mitigation measure is based on its findings throughout the tentative and final site decision process relative to the environmental impacts resulting from the construction of the harbor island treatment plant on either island with the existing institutions present, and the benefit to be gained by the removal of the existing institution from the island selected as the site for the treatment plant. Many of those findings, as they relate to Deer Island were addressed by the Secretary in his Certificate as well as by numerous commentors to the FEIR, all of whom found the relocation of the prison to be a required mitigation measure. The MWRA's findings on benefits which would result from relocation of the prison are summarized as follows.

The MWRA found that the reliability of the treatment plant would be greatly enhanced by providing sufficient space for optional design. The converse was also found, that building on Deer Island with the treatment plant present would require a cramped design with reduced space between piping and flow controllers resulting in decreased uniformity of flow and reduced control over the treatment process. This, in turn, would increase the possibility of operational malfunctions or decrease the ability to monitor or redress such episodes, resulting in adverse impacts on neighbors of the treatment plant.

The MWRA also found that building the treatment plant in such close proximity to the prison would cause severe visual and noise impacts on the persons living and working in that institution. The noise impacts on the prison would be above the legal standard and would require extraordinary mitigation measures to be undertaken to ameliorate the effect. Mitigation measures, such as buffers or berms, would place additional area demands on an already constrained site. Other measures, such as timing and placement of construction and equipment could adversely impact the length of construction time. Removal of the prison would eliminate such impacts and the need for such mitigation measures.

Relocation of the prison would also reduce costs. The cost of constructing the treatment plant on a constrained site with the prison present, of operating and maintaining the plant under those conditions, and of providing the necessary mitigation measures to

alleviate the proximity of the treatment plant to the prison would be significantly greater than building without the prison.

Finally, additional benefits to recreators and to non-prison receptors would accrue from the removal of the prison. Those benefits would include alleviating the visual impact of the treatment plant on Winthrop receptors by providing space for screening and modifying landforms, providing space for recreational and open land use, reducing traffic on Winthrop's streets by the approximately 114 autos a day currently used at the prison, substantially alleviating the combined impact of regional facilities on the Town of Winthrop and by enhancing the safety of the community.

For all these reasons and the reasons cited by the Secretary, some of which are echoed by other commentors, the MWRA considers the removal of the Deer Island House of Correction to be essential to the expeditious construction of new treatment facilities.

Further Measures to be Examined

The commitments to mitigation listed above comport with all mitigation measures which would be required under the MEPA statute. In fact, in many instances, as noted by the Secretary in his certificate on the FEIR, the MWRA has addressed many issues to a far greater degree than was required and has made commitments in these areas accordingly.

Nevertheless, the Secretary, in his final Certificate, has made recommendations that certain measures be undertaken either sooner than might be required or with respect to current facilities as opposed to the new treatment plant which is the subject of the FEIR.

The MWRA considers these suggestions positive and worthy of serious review. It has directed staff to evaluate the Secretary's suggestions and to recommend within thirty to ninety days where, when and how they may be responded to and the nature of the recommended response. The suggestions by the Secretary include:

1. The "Sewer Bank" concept be further explored and feasible programs developed to eliminate excess flow and accommodate new connections.

2. Accommodate future growth within the service area through satellite plants.

3. Continued and strengthened programs to monitor flows to provide sound data to gauge the effects of flow management.

4. Implement odor panel and formal odor complaint response at existing facility.

5. Consider real time monitoring of odors, perhaps using hydrogen sulfide as an indicator.

6. Consider development and implementation of a monitoring program for VOCs and other air toxics in the wastewater stream and in the ambient air.

7. Recommend implementation of an acoustic Review Board to monitor and respond to noise complaints at existing facility; and supplement such a noise program now and at the new treatment plant with periodic noise monitoring.

Summary of Impacts and Findings of Limitation of Impacts

The MWRA finds that the environmental impacts resulting from the construction of the Boston Harbor wastewater treatment facility are those impacts as described in the Draft Environmental Impact Report, elaborated on and refined in the Final Environmental Impact Report and commented upon in these G.L.C. 30, Section 61 Findings.

The MWRA further finds that its selection of Deer Island as the site for the wastewater treatment facility, and its commitment to the mitigation measure set out in the Commitments to Mitigation section of these G.L.C. 30, Section 61 Findings constitute all feasible measures to avoid or minimize the environmental impacts described.

Record of Decision

The text of EPA Region I's Record of Decision on the Final Environmental Impact Statement Siting of Wastewater Treatment Facilities for Boston Harbor is as follows:

The U.S. Enviromental Protection Agency (EPA) has prepared this document as its Record of Decision (ROD) for the Final Environmental Impact Statement (FEIS) on the siting of the Massachusetts Water Resources Authority (MWRA) wastewater treatment faciities which will abate the pollution of Boston Harbor.

The MWRA has the responsibility of selecting the site for the wastewater treatment facilities. EPA's primary responsibilities are to conduct an evaluation of environmental acceptability under the National Environmental Policy Act (NEPA), provide federal financial assistance if available, and ensure rapid compliance with the Clean Water Act.

EPA issued a Supplemental Draft EIS (SDEIS) in December, 1984 and a FEIS on December 2, 1985 on the siting of wastewater treatment facilities for Boston Harbor. These documents evaluated the environmental impacts of various site options for facilities to treat Greater Boston's wastewater in compliance with water pollution control laws. The SDEIS also served as a Draft Environmental Impact Report (DEIR) under the provisions of the Massachusetts Environmental Policy Act (MEPA) for the Metropolitan District Commission (MDC). Since publication of this joint document, the sewer functions of the MDC have been reorganized into the MWRA. The Board of Directors of the MWRA chose to follow an independent but parallel decision process and to publish a separate but concurrent Final Environmental Impact Report (FEIR) under state law.

Following the concurrent publication of EPA's FEIS and MWRA's FEIR, EPA and MWRA conducted joint public hearings before reaching their respective final decisions. Public hearings were held on January 13, 14 and 15, 1986 in Quincy, Boston and Winthrop. Oral and written comments were submitted during the comment period. The public comment period ended on January 21, 1986 for the FEIS and January 24, 1986 for the FEIR.

In February, 1986, the MWRA determined that "the most appropriate site for the harbor island wastewater treatment facility is Deer Island." This ROD identifies EPA's final decision on the siting issue. This ROD is being circulated to inform the public of this decision and to respond to the comments on the FEIS.

I. EPA's FINAL DECISION ON THE SITING OF SECONDARY WASTEWATER TREATMENT FACILITIES FOR BOSTON HARBOR

With the understanding that EPA will require the MWRA to carry out the program of specified mitigation measures identified on pages 52-55 of the FEIS, Volume I, EPA's decision is that its preferred alternative is the All Secondary Deer Island alternative set forth in the EIS and described below. All Secondary Long (without the hospital) is also environmentally acceptable and is preferred over Split Secondary Deer-Long (without the hospital). The only alternative which EPA finds unacceptable is Split Secondary Deer-Nut. The decision process and the program of required mitigation measures is described in more detail in Section III.

EPA's preferred alternative for secondary treatment, All Secondary Deer, would expand the existing primary wastewater treatment facility at Deer Island to a secondary treatment plant. It would reduce the existing primary treatment facilities at Nut Island to a small headworks. It would include construction of a major new pipeline or tunnel from Nut Island to Deer Island and of an effluent outfall to the east of Deer Island Light. The existing wastewater treatment facility on Deer Island would be increased from 26 acres to about 115-140 acres while on Nut Island the existing wastewater facility would be reduced from 12 acres to about 2 acres.

This alternative would commit almost all the land on Deer Island south of the existing prison to wastewater treatment and level the most prominent topographic features of the island. This alternative would also require the construction of a bulk materials loading pier(s) and roll-on roll-off facilities at the site, and associated terminal(s) on-shore.

The estimated construction cost of this alternative would be about $1.135 billion and its annual cost of operation, maintenance and replacement would be about $50 million. Costs, acreage requirements, exact plant layout and mitigation measures will be developed in greater detail during further facilities planning on the project.

The Benefits of Moving the Prison

The MWRA favors a variation of the All Secondary Deer Island alternative which assumes that the prison would be removed as a mitigation action, and that its site would be made available for the treatment plant. This variation would also use most of the Island but prison removal would reduce the impacts of the treatment plant in several ways:

1. It would remove the receptor population (the prison workers and inmates most affected by the plant's impacts, including noise and odor).

2. It would eliminate prison-related traffic, thus offsetting construction-related and operations traffic for the treatment plant.

3. It would improve the appearance of Deer Island by removing the prison buildings.

4. It would permit opportunities for sculpting the landscape to a more natural appearance and for screening the facility from both the harbor and Point Shirley and Cottage Hill in Winthrop.

5. It would increase the opportunity for buffering noise at Point Shirley by earthen barriers on prison property.

6. It would permit the retention of a portion of the Island's shoreline for buffering and recreation.

7. It would remove prison-related anxieties from Winthrop.

8. It would make more land available for the wastewater treatment facility, possibly making construction and maintenance easier.

This variation does not eliminate the need for any of the mitigating actions proposed for the All Secondary Deer Island alternative with the prison to remain, except for those intended to reduce impacts at the prison itself, e.g., a noise barrier.

However, the process required to release the Deer Island prison site for treatment plant use could be so lengthy as to delay or frustrate the construction of this variation of the All Secondary Deer Island alternative. EPA has long advocated removal of the prison if Deer Island is to be the treatment plant site, but EPA will not require removal of the prison as a grant condition. Implementation of secondary treatment is required by the Clean Water Act and cannot be made dependent upon removal of the prison if the site is acceptable.

This ROD concludes that in EPA's judgement the All Secondary Deer Island Alternative is its preferred alternative and can be implemented without unacceptable environmental

impacts even if the prison remains.*

II. SELECTION OF ALTERNATIVES FOR EVALUATION

Federal regulations require EPA, during environmental review, rigorously to explore all reasonable alternatives for the siting of wastewater treatment facilities for Boston Harbor. Most of the alternatives initially investigated were derived from the EPA's 1978 Draft Environmental Impact Statement (DEIS), which examined only secondary treatment options, and the MDC's 1982 Nut Island Site Options Study. The Site Options Study identified eleven alternatives (eight secondary and three primary treatment alternatives), including some previously examined in the DEIS. In September, 1983, EPA and the Commonwealth conducted two public scoping meetings to receive comments on these initial alternatives from the public and from federal, state and local officials. Upon completion of the joint scoping meetings, EPA selected eleven additional alternatives for analysis, for a total of twenty-two alternatives to be studied. These included twenty alternatives for treatment at Deer, Long, Nut, or man-made islands and two alternatives including sub-regional "satellite" plants. A complete discussion of the twenty-two initial primary and secondary alternatives appears in the SDEIS at Vol II, Section 12.12. Table I is a complete list of the twenty-two initial options.

[See Table I on page 3-38 in this Section.]

III. DECISION PROCESS

To examine such a large number of alternatives, a screening process was developed jointly with the Commonwealth. Its objective was to narrow the number of alternatives being investigated and to eliminate those that clearly offered few benefits or had significant adverse impacts. This initial screening of alternatives is summarized here; it is described in detail the SDEIS. Each alternative's economic, social and environmental impacts were studied. In addition, their technical, legal, institutional and political problems were also analyzed. Specific criteria were developed for comparison and screening of the options.

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* The Clean Water Act requires that wastewater treatment plants be constructed which will provide "secondary" treatment unless EPA, under strict statutory guidance, grants a waiver, under Section 301(h) of the Clean Water Act, permitting a lesser "primary" degree of treatment with a deep ocean dicharge. EPA has twice denied the MDC/MWRA request for such a waiver but final rights of appeal have not expired. EPA believes it is highly unlikely any such appeal, even if pursued, would prevail on the merits, or that the discharge of primary effluent into Massachusetts Bay would ultimately be permitted over the opposition of the Governor and other officials. However, in the interest of completing the NEPA review, EPA has decided in this ROD to resolve the siting of a primary treatment plant as well. The decision is the All Primary Deer Island alternative.

TABLE I

LIST OF TWENTY-TWO INITIAL OPTIONS STUDIED IN THE SDEIS

Secondary Treatment Alternatives

1a.1 Secondary Treatment at Deer Island, Headworks at Nut Island with separate North and South System Secondary Treatment Processes.

1a.2 Secondary Treatment at Deer Island, Headworks at Nut Island with combined North and South System Secondary Treatment Processes.

1b.1 Secondary Treatment at Deer Island, Primary Treatment at Nut Island for South system, separate North and South System Secondary Treatment Processes.

1b.2 Secondary Treatment at Deer Island, Primary Treatment at Nut Island for South System, combined North and South System Secondary Treatment Processes.

1c Secondary Treatment at Deer Island for North System, Secondary Treatment at Nut Island for South System.

2a.1 Secondary Treatment at Deer Island for North System, Secondary Treatment at Long Island for South System, Headworks at Nut Island.

2a.2 Secondary Treatment at Deer Island for North System, Secondary Treatment at Long Island for South System, Primary Treatment at Nut Island.

2b.1 Headworks at Deer Island for North System, Headworks at Nut Island for South System, Consolidated Secondary Treatment at Long Island.

2b.2 Primary Treatment at Deer Island for North System, Primary at Nut Island, Consolidated Secondary Treatment at Long Island.

2b.3 Headworks at Nut Island, Primary Treatment at Deer Island for North System, Consolidated Secondary Treatment at Long Island.

3a Headworks at Deer and Nut Islands, Consolidated Secondary Treatment at Lovell's Island.

3b Headworks at Deer and Nut Islands, Consolidated Secondary Treatment at a new man-made island.

Primary Treatment Alternatives

4a.1 Primary Treatment of All System at Deer Island, Headworks at Nut Island. Local Outfalls.

4a.2 Primary Treatment of All System at Deer Island, Headworks at Nut Island. Deep Ocean Outfalls.

4b.1 Primary Treatment at Deer Island for North System, Primary Treatment at Nut Island for South System, Local Outfalls.

4b.2 Primary Treatment at Deer Island for North System, Primary Treatment at Nut Island for South System, Deep Ocean Outfalls.

5a.1 Primary Treatment at Deer Island for North System, Primary Treatment at Long Island for South System, Headworks at Nut Island. Local Outfalls.

5a.2 Primary Treatment at Deer Island for North System, Primary Treatment at Long Island for South System, Headworks at Nut Island. Deep-Ocean Outfalls.

5b.1 Headworks at Deer and Nut Islands, Consolidated Primary Treatment at Long Island. Local Outfalls.

5b.2 Headworks at Deer and Nut Islands, Consolidated Primary Treatment at Long Island. Deep-Ocean Outfalls.

Satellite options 1&2 - Satellite facilities for South System with discharge to Charles and Neponset Rivers. Satellite facilities for South System with wetlands discharge.

In screening the initial alternatives, it became clear that no alternative was without some potentially adverse impacts. Furthermore, no alternative satisfied all of the criteria used in the analysis. Considering the size and complexity of the project, virtually all alternatives were considered to have at least one or more drawbacks that limited their acceptability to some affected group(s).

The initial screening process concluded that of the twenty-two alternatives studied, four secondary treatment options and four primary options conformed to these criteria and warranted further investigation and more detailed study. These alternatives reflected different approaches to the siting requirements of the MDC system. The impacts of these options also varied in their respective advantages and disadvantages. The eight alternatives are identified below according to their abbreviated names used in the EIS. (Parenthetical references in Table I refer to the nomenclature used in the initial screening process.)

a. Secondary Treatment (Harbor Entrance Outfall) Alternatives:

1. All Secondary Deer Island (1a.2)

2. Split Secondary Deer Island and Nut Island (1b.2)

3. All Secondary Long Island (2b.1)

4. Split Secondary Deer Island and Long Island (2b.3)

b. Primary Treatment (Nine Mile Outfall) Alternatives:

1. All Primary Deer Island (4a.2)

2. Split Primary Deer Island and Nut Island (4b.2)

3. All Primary Long Island (5b.2)*

4. Split Primary Deer Island and Long Island (5a.2)

A detailed assessment of the impacts of these alternatives was provided in the SDEIS. Figure I shows the eight alternatives with their respective facilities and harbor locations.

During the further preparation of the SDEIS, relevant Massachusetts agencies and the EPA agreed that it was necessary to refine the decision process because of the complexity of the siting decision and the great number and variety of factors which must be taken into account by decision-makers. The first step was to re-analyze the various arguments and considerations that had been brought to bear on this controversial siting decision by all concerned parties in order to determine their disparate objectives. These objectives were used to develop a more precise set of decision criteria against which the remaining alternatives were to be evaluated. It was the goal of the SDEIS to make the list short, yet inclusive of all concerns that had been raised. Six decision criteria were identified. Each alternative was to be evaluated to determine the extent to which it:

1. is consistent with and, if possible, promotes the fulfillment of the promise of Boston Harbor. (Harbor Vision)

2. can be implemented in a timely and predictable manner. (Implementability)

3. minimizes the adverse impacts of the facility on neighbors, taking into consideration existing conditions, facility siting impacts and mitigation measures. (Effects on Neighbors)

4. minimizes the impacts of the facilities on natural and cultural resources. (Impact on Cultural and Natural Resources)

5. can be built and operated at a reasonable cost. (Cost)

6. maximizes the reliability of the entire treatment system. (Reliability)

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* Though the SDEIS/EIR suggested that one alternative, All Primary Long, should also be screened out and not receive further active consideration, the SDEIS/EIR and the FEIS contained a full evaluation of All Primary Long. EPA considers that all eight alternatives received an equal level of analysis.

Finally, EPA and the Commonwealth developed a comprehensive program of mandatory measures applicable to all alternatives: barging of materials, busing of workers, and noise and odor control.

Thus, in the SDEIS/EIR, EPA and the Commonwealth had narrowed the options remaining for secondary or primary treatment from twenty-two to eight alternatives, but had not arrived at a statement of two preferred alternatives, one for secondary treatment and one for primary treatment. The most important factor leading to this outcome was a desire on the part of both EPA and the Commonwealth to encourage public scrutiny and obtain formal public comment on the results of initial screening process, the large amount of new data, the new decision criteria and the proposed mandatory mitigation before proceeding to suggest two preferred alternatives.

After the close of the SDEIS/EIR public comment period, in light of the high degree of public acceptance, EPA decided to retain criteria as a way to impose order on a mass of detail in this especially complex review, and to focus on those impacts which are relevant to the choice of a site. EPA also reviewed all the public comments submitted to identify both those criteria-relevant issues which needed futher analysis prior to selection of a preferred alternative and those other issues which related to the overall project or were otherwise not criteria-relevant, but which were appropriate for inclusion in the FEIS or the FEIR. EPA performed additional analyses on potentially site-relevent topics.

EPA and the MWRA agreed that it was appropriate for each to pursue an independent decision-making process under their respective statuatory mandates but to do so in parallel and with a high degree of coordination. Accordingly, to ensure that both agencies shared a common data base, as either agency identified data needs or developed information, it was shared with the other by exchange of technical memoranda and through technical presentations at meetings with EPA's Technical Advisory Group or with the MWRA's Board of Directors or staff.

EPA systematically reviewed its entire data base using the decision criteria and evaluated each piece of data in terms of one or more of the appropriate decision criteria. EPA felt that each decision criterion was legitimate and was confident that sufficient objective data existed to permit a reasoned judgement as to the acceptability of the alternative sites.

Mandatory Mitigation Measures

Upon the completion of the review of each decision criterion, the assumed level of mandatory mitigation as set forth in the SDEIS/EIR was either confirmed or, if appropriate, modified as the result of further technical information. EPA found that the most critical need for mitigation was to reduce impact on neighbors. EPA applied a set of specific mandatory mitigation measures to all alternative sites except as noted below. The mandatory mitigation measures can be summarized as follows:

- o Barging of bulk materials to and from the site to reduce the amount of trucking through affected communities during construction;

- o Use of a roll-on/roll-off barge loading facility at the site and at an onshore transfer station to accommodate heavy trucking;

- o Busing and ferrying of construction workers to reduce commuter traffic in affected communities during the construction period;

- o Use of "maximum feasible degree" of odor control and investigation of state-of-the-art odor control technology;

- o A ban on the use of liquid chlorine at Deer Island unless there is "clear and convincing" need for it and proof that it can be handled without unnecessary risk to neighbors, including the prison workers and inmates;

- o Implementation of noise control measures during construction, including the excavation of the Deer Island drumlin from the south side so that the remaining mass of the drumlin acts as a shield, and construction of a sound barrier at the Deer Island prison.

- o Prohibition against trucking liquid chlorine to Deer Island as soon as piers and staging areas are available to commence over-water transport;

- o Exploration of alternatives to the use of liquid chlorine at the treatment plant and at the associated headworks;

- o Sampling of volatile organic compounds downwind from the existing primary plants at Deer and Nut Islands, exploration of technologies to control these compounds and installation of appropriate controls if necessry;

- o Exploration of alternative treatment processes that might be less space demanding, less costly, or more reliable than secondary treatment based on the activated sludge process;

- o Exploration of the feasibility of developing recreational uses of the site along with the treatment plant;

- o Control of dust, erosion and sedimentation.

For a detailed statement of the mandatory mitigation measures, see pages 52-55 of the FEIS Volume I. Each of these mitigating efforts will be the subject of detailed study by the MWRA as further facilities planning explores these ways of achieving acceptable levels of impact. EPA, after appropriate environmental review, is prepared to modify these mitigation measures if equally effective protection can be achieved by other methods.

In the judgement of EPA, these stringent mandatory mitigation measures include all practicable means which are necessary and appropriate to avoid or minimize environmental harm from the alternative selected. EPA acknowledges that in some cases its mitigation package differs from the mitigation commitments described in the MWRA's FEIR and its findings under Section 61 of MEPA. EPA is confident, however, that its mandatory mitigation measures would result in an extraordinary degree of mitigation which would effectively minimize environmental harm.

Final Analysis*

During the final analysis, it became clear that three of the decision criteria, through theoretically important, no longer played site-distinguishing roles.

1. On "Cost," a more detailed analysis revealed that the costs of the four alternatives were so close that EPA decided to regard this decision criterion as having neutral effect.

2. On "Reliability," each of the sites permitted treatment plants of equal reliability.

3. On "Impact on Cultural and Natural Resources," though this decision criterion included federally protected resources (wetlands, barrier beaches, recognized historical and archeological sites, etc.), the impact of plants on either Deer or Long Island would be essentially equal and acceptable. On Nut Island, however, the Split Secondary Deer-Nut Alternative would involve the serious impacts of filling of tidal areas (unless homes were taken) and this was taken into account in the final decision.

Thus, "Effects on Neighbors," "Harbor Vision," and "Implementability" remained as the principal decision criteria for EPA. EPA felt each of these three criteria represented protection of important public values of substantial weight and each will be discussed below:

1. With respect to the "Effects on Neighbors" decision criterion, should the "no prison" variation of the All Secondary Deer Island alternative be implemented, EPA concluded that a treatment plant at either Deer Island or Long Island would have acceptable and essentially equal impacts on its neighbors, with the mandatory mitigation measures in place. However, if the prison were to remain on Deer Island, EPA concluded

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* In the following discussion it is important to note that, in the SDEIS/EIR, EPA and the Commonwealth concluded that under both Long Island alternatives, the Long Island hospital must be relocated off-island in order to avoid unacceptable impacts to "Effects on Neighbors," "Harbor Vision," and "Cultural and Natural Resources." EPA believes this conclusion remains valid.

that a plant site on Deer Island would have a greater effect on its neighbors than a site on Long Island, but these impacts as mitigated were acceptable. EPA felt that removal of the prison was desirable but not mandatory. EPA also concluded that the mandatory mitigation reduced the impacts so substantially that the plant could be constructed without unacceptable impact despite the presence of the airport and the prison.

The Split Secondary Deer-Long alternative would involve major construction activity of approximately the same perceived effect on the neighbors of each island as if the entire plant were being constructed there. Though those effects were found to be acceptable, it was felt to be unwise to impact two sets of neighbors unless there would be some benefit to another decision criterion; there was not.

Split Secondary Deer-Nut imposed severe burdens on its immediate neighbors on Hough's Neck without any corresponding benefit to Deer Island and Point Shirely. It was found to be environmentally unacceptable.

2. Considering only the "Harbor Vision" decision criterion, EPA concluded that though all four alternatives were acceptable, the All Secondary Deer alternative was preferred under "Harbor Vision". EPA believes that Deer Island's size, topography and setting give it acceptable long-term potential for rehabilitation as a park resource. However, because of Long Island's current potential as a major island park, EPA did conclude that while both All Secondary Deer and All Secondary Long satisfied the Harbor Vision decision criteria, All Secondary Deer satisfied it better.

Less acceptable were the other two alternatives. Though Split Secondary Deer-Long preserved significant potential recreation space at each island, EPA agreed with the Commonwealth that an entire island as park was preferable. Split Secondary Deer-Nut committed Nut Island to wastewater treatment without any corresponding benefit at Deer Island; though Nut Island has not been a major part of a harbor park plan, it could provide locally important open space.

3. Considering only the "Implementability" decision criterion, the following issues were of principal importance: permits and licenses, and the attitudes of the City of Boston and agencies and legislature of the Commonwealth. Even prior to the July 10, 1985, vote of the MWRA selecting All Secondary Deer Island as its tentative preferred alternative, EPA had concluded that the "Implementability" decision criterion pointed to All Secondary Deer with or without the prison because the principal remaining alternative, All Secondary Long (without the hospital), faced significant opposition. However, EPA was concerned that Deer Island prison removal was uncertain.

The July 10, 1985, and February, 1986 votes, and the MEPA Sec. 61 Findings of the MWRA, the proposing agency, which has the statutory authority to build the treatment plant and which controls much of Deer Island, confirmed EPA's conclusion that the All Secondary Deer alternative was clearly more implementable than any of the other alternatives.

The Governor's continued support of the MWRA, his renewed commitment to facilitate

relocation of the prison, and his new offer to identify a new prison site by May, 1986, further supports this result. Other officials have reiterated their support for prison removal if Deer Island is to be the site. As stated by the Secretary of Environmental Affairs in his Certificate on the FEIR, Janury 21, 1986:

> "...[T]hrough the joint struggle of all branches of government, the courts, the press, and the public, important milestones have now been passed - the creation of the Authority and public consensus on siting. A momentum has now built up, which I consider so powerful that the cleanup cannot and will not be stopped. The joint will of Mayor Flynn, Governor Dukakis, the General Court and our citizens is so strong that I am convinced the difficulties of prison relocation can be overcome..." (emphasis added)

EPA agrees with the MWRA that the reinforced support of relevant public officials for Deer Island prison removal and the continued opposition to Long Island Hospital removal makes prison removal "far more feasible" than hospital removal.

Furthermore, even if the prison were to remain, EPA notes the continued strong opposition of the city and state officials who control the future of Long Island to any use of Long Island as a treatment plant and notes their reiterated support for a Long Island park and for a continued role for the Long Island Hospital and Homeless Shelter.

Therefore, EPA confirms its previous judgement that All Secondary Deer Island (even if the prison were to remain) is more implementable than either of the other two environmentally acceptable alternatives: All Secondary Long and Split Secondary Deer-Long (both without the hospital).

In summary, with mandatory mitigation,

1. EPA found Split Deer-Nut to be environmentally unacceptable because of its severe impact on its "Neighbors" at Nut Island and on "Natural Resources," and strong barriers to "Implementability."

2. EPA found Split Deer-Long (without the hospital) to be environmentally acceptable; but EPA also found it to be undesirable because it spreads impacts on "Neighbors" and "Harbor Vision" to two islands without any benefit deemed valuable to a decision criterion. It also was unlikely to be "Implemented."

3. EPA found both All Secondary Long (without the hospital) and All Secondary Deer to have an acceptable impact on "Neighbors" and "Harbor Vision."
   a. "Neighbors." With mitigation, the impact of a Deer Island plant on its "Neighbors" is either equal to (without the prison) or worse than (with the prison) a Long Island plant.

b. "Harbor Vision". The impact of a Deer Island plant on the public benefits from and uses of Boston Harbor causes somewhat less harm than a Long Island plant.

c. "Implementability". Between these two acceptable and closely balanced alternatives, building a treatment plant on Deer Island (with or without the prison) is clearly more "Implementable" than building a Long Island Plant.

EPA's decision based on the foregoing analysis is that its preferred alternative is All Secondary Deer with mandatory mitigation. The FEIS contains more information on the decision process.

IV. IMPLEMENTATION, MONITORING, ENFORCEMENT OF MITIGATION MEASURES

Applicable regulations require EPA, in this ROD, to adopt and summarize an implementation, monitoring and enforcement program for its mitigation measures.

EPA's first implementation, monitoring and enforcement mechanism will be through the construction grants program. Section 201(g) of the Clean Water Act authorizes the Administrator to grant financial assistance to municipalities for the construction of municipal wastewater treatment plants. Section 511(c) of the Act states that the award of a construction grant may be considered a major federal action significantly affecting the quality of the human environment, subject to the requirements of NEPA. These statutes give EPA the authority to enforce the mandatory measures through the federal construction grants program. The mandatory mitigation measures for the selected site at Deer Island will be made necessary conditions of any Federal construction grants awarded to the MWRA during the Step 3 Construction Phase of this project.

EPA has determined, pursuant to Section IV B 7 of the 1984 Construction Grants Delegation Agreement and 40 CFR Section 3015(c), that an overriding federal interest exists in this project, in particular in regard to the implementation of the mandatory mitigation program specified in the FEIS. In order to ensure that all mandatory mitigation measures are implemented through the construction grants program, the agency will play a direct role in oversight of facilities planning, design and construction of the wastewater treatment plant including piers, outfalls and pipelines/tunnels. The specific role that EPA plans to play will be at least as follows:

- o review all sections of all the facilities plans to ensure compliance with the mandatory mitigation program as set forth in FEIS Volume I, p.53-55.

- o coordinate with the Massachusetts Department of Environmental Quality Engineering (DEQE), Division of Water Pollution Control in reviewing the plan of study for the facilities plans.

- o participate in any technical and citizen advisory committees as part of the public participation program for the facilities plan.

- o participate in the review of the draft products of the facilities plans, particularly the development of the mandatory mitigation measures.

- o EPA will review at least the specifics of the proposed odor control program, noise control program and possible volatile organic compound emissions control program to ensure that MWRA is achieving effective impact reductions required by this ROD. On the issue of liquid chlorine use, EPA will ensure in its review of the facilities plan that MWRA has undertaken a thorough disinfectant alternatives analysis. On the issue of busing, ferrying and barging, EPA will monitor the development of the facilities planning investigations to ensure that MWRA establishes the required programs to mitigate transportation impacts.

- o coordinate with DEQE for joint review and approval of the final facilities plans. The facilities plans will be approved only upon successful development of the mitigation program as outlined in the FEIS.

- o EPA will request the Army Corps of Engineers, during construction, to make periodic onsite reviews to ensure that the project is being managed properly, is on schedule, and is being constructed in accordance with approved construction drawings and specifications including mitigation measures and change orders.

In order to facilitate a high degree of review oversight by EPA, the agency intends to enter into an agreement with the DEQE Division of Water Pollution Control and MWRA to outline further details of EPA's oversight.

In addition to EPA oversight and participation in further facilities planning, EPA intends to assume primary responsibility for NEPA review by the preparation of any environmental assessments or supplemental EIS's determined to be necessary in connection with these activities. EPA and the Army Corps of Engineers plan to enter into a Memorandum of Understanding in order to minimize delays in any environmental reviews involving both agencies.

Second, the MWRA is under federal court order to initiate facilities plans for the shore-side piers and staging areas, on-site piers and staging areas, outfalls and tunnels or piplines. The MEPA unit of the Executive Office of Environmental Affairs has made the determination that EIR's will be prepared on these facilities plans. In addition, the facilities plans will include EID's which provide environmental evaluations of the final facilities plan components. EPA will conduct an independent environmental review, under NEPA, of these facilities plans, except for those aspects of the wastewater treatment plant covered by this EIS.

Third, in the unlikely event that federal funding for this project were to be totally unavailable due to the termination of the Construction Grants Program, this project will require other federal actions which bring it within NEPA. These include the transfer of surplus federal lands by the General Services Administration (GSA); permit actions by the Corps of Engineers for the construction of piers and the disposal of dredged material or fill; and possible permit actions by EPA for the ocean disposal of fill. Each of these actions triggers independent opportunities to implement and enforce the mitigation program. For example, GSA intends to dispose of the surplus property in accordance with the FEIS and has committed to incorporate the mandatory mitigation measures into its own Record of Decision as appropriate.

Fourth, this project is now the subject of a federal court action (United States of America v. Metropolitan District Commission, et al., Civil Action No. 85-0489 D.C. MA and a related case.) In the event of the cessation of the construction grants program, EPA will also consider seeking an order of the federal court mandating that the mitigation program laid out in the FEIS be implemented.

Fifth, it should also be noted that the MWRA has committed to the Commonwealth that it will undertake a set of mitigation measures which are, with the exception of prison removal, substantively equivalent to those required by EPA. These are contained in the Section 61 Findings of the MWRA to the Secretary of Environmental Affairs under the MEPA.

[See also Section 3.2.11 (FINAL SELECTION) of this Volume.]

FURTHER ENVIRONMENTAL REVIEW UNDER NEPA

EPA expects that further environmental review under NEPA relating to the cleanup of Boston Harbor will include appropriate study of the following phases of the process, including cumulative impacts:

1. Long-term residuals management, including the processing, transport and ultimate disposal of sludge. Scoping for this EIS has already commenced.

2. The construction of pier(s) and staging area(s) at the treatment plant site and on shore to allow for barging of bulk construction materials, equipment, and work crews during construction, and possible transport of sludge. In the event that an existing pier cannot be located on the mainland, an additional pier or piers and staging area(s) would need to be constructed there.

3. The construction of an under-harbor tunnel or pipeline to transport wastewater to the treatment plant.

4. The water quality and construction impacts of an outfall pipe or pipes through which effluent will be discharged.

5. The possible disposal of earthen or dredge materials which might need to be removed from the site of the secondary treatment plant prior to construction.

6. The possible transport, handling, storage, and use of chlorine at the secondary treatment plant, depending upon the outcome of studies by MWRA regarding the environmental acceptability of its transport, handling, storage and use.

7. Combined sewer overflow projects.

CONCLUSION

EPA has engaged in a decision process which gathers technical information, exposed it to extensive public scrutiny, developed very stringent mitigation measures, and evaluated the alternatives in terms of disclosed decision criteria. EPA believes this open process has arrived at a fair and reasonable conclusion that the upgraded treatment plant, considered singly or in combination with other conditions, will be constructed and operated with acceptable environmental results.

3.3 RELATED PROJECTS

3.3.1 PROJECTS

Although the Secondary Treatment Facilities Plan is the beginning of the key project in the Boston Harbor Cleanup Program, there is a long list of projects that are being planned, designed or are under construction to upgrade and expand the MWRA's wastewater collection and treatment capabilities. These projects are grouped into the following programs:

Treatment Plant Upgrade
  Nut Island Immediate Upgrade
  Deer Island Fast Track Improvementss
Interim Residuals Management
  Interim Sludge Processing and Disposal
  Interim Scum Management
Long-Term Residuals Management
Water Transportation Facilities
Combined Sewer Overflows
Harbor Research and Monitoring

In addition to the above wastewater programs, several waterworks projects have either a direct or an indirect bearing on the secondary treatment facilities planning. MWRA has also initiated several projects to strengthen its ability to direct and manage its extensive capital program and its extensive day-to-day operational responsibilities. The projects designed to strengthen

MWRA's institutional capability are described in Volume VII, Institutional Considerations. The related wastewater programs are described briefly in the following paragraphs.

3.3.2 INDUSTRIAL WASTE PROGRAM

In February of 1973, MWRA's Industrial Waste Program began to acquire data on all industries within the 43 cities and towns which comprise the sewerage district. This program has become the means whereby the Authority enforces Federal, State and MWRA regulations which govern the discharge of wastewater to the sewer system. The goals of the enforcement strategy are to decrease and control pollution loads to the treatment works; increase safety for maintenance and operational personnel; reduce illegal waste discharges such as extraneous water and septage from non-member municipalities; and prosecute for willful damage or vandalism.

The Industrial Waste Program, which was approved by the EPA in July of 1982, is being implemented in four phases: Inspections, Monitoring, Permitting and Enforcement.

Inspection Activities

The inspection program includes on-site inspection of all indusries in the district. It requires a discussion period with appropriate plant personnel to ascertain the type of activity being performed at the facility, the raw materials used, products and services produced, and the particular processes and unit operations employed. A tour of the facility is also conducted to verify the information received. Industries suspected of discharging a questionable waste are required to submit the results of laboratory analyses, performed on representative samples of the process waste by an independent laboratory, for review and evaluation by the Authority. The results of analyses, along with other pertinent information (permit application, inspection reports) on the industry, are used to determine whether or not the wastes are in compliance with the MWRA's Rules and Regulations. A permit application must be completed by all users discharging industrial wastes.

An intensified Industrial Inspection Program has commenced as a result of the increase in staff and resources. In Fiscal Year 1987, approximately 425 industrial inspections were conducted.

Septage Disposal Inspection Program

The Septage Disposal Inspection Program is basically divided into two activities: first is the oversight of the septage control activities of the member municipalities with septage receiving locations; and second is surveillance of each septage receiving location to determine compliance with MWRA Rules and Regulations and to identify any illegal septage dumping.

Each member municipality which operates or has designated a septage receiving station is responsible for the control and monitoring of all activities at the septage receiving location. The Water Quality Section evaluates control procedures at each septage receiving location for the purpose of determining the municipality's ability to control the dumping of septage from

non-member communities, to prevent the discharge of industrial or toxic wastes, and to verify the origin of all septage received at each septage receiving location.

In some instances the possibility of illegal or uncontrolled dumping at certain septage receiving locations is suspected. In response to these instances, surveillance of the septage receiving site is conducted in order to document septage disposal, and possibly identify illegal dumping activities requiring enforcement of dumping restrictions.

Identification of I/I and Surcharging During Routine Investigations

In addition to identifying sources of toxic discharges to the sanitary sewer system, investigations at industrial facilities often identify the illegal discharge of "clean" water, also known as inflow. During these industrial investigations the most common form of inflow uncovered is non-contact, uncontaminated cooling water and non-contact, uncontaminated industrial process water.

In addition to identifying these and other sources of inflow, inspection personnel often identify excessive use of water and make recommendations to limit water use. These recommendations serve to reduce the flow in the already overloaded sewer system, which helps to minimize surcharging.

Monitoring Activities

The Monitoring Section of the Water Quality Department continually participates in a variety of activities, the most significant being monitoring for the Industrial Waste Pretreatment Program. More specialized areas of monitoring include sampling at the Treatment Plants, fulfilling NPDES Permit monitoring requirements, soil sampling, beach sampling, and verification of discharges and connections. Monitoring activities during Fiscal Year 1987 numbered 565, compared to 200 in Fiscal Year 1986.

Collection of industrial waste samples from industries discharging into the Authority's Sewer System yields a profile of industrial wastes currently entering the system and provides the basis for enforcement to eliminate unacceptable concentrations of toxic and potentially harmful substances. The samples collected are forwarded to a laboratory for analysis, where strict Quality Assurance/Quality Control procedures are employed. Analytical results from this monitoring, in conjunction with information derived from inspecting and permitting activities, assist in determining the acceptability of the discharge and whether enforcement action is warranted.

The Monitoring Team has been involved in site assessment and the implementation of the monitoring program to fulfill the NPDES Permit requirements. The permit requires monitoring at Deer and Nut Island Treatment Plants and at three Combined Sewer Overflow (CSO) facilities (Cottage Farm Chlorination and Detention Station, Charles River Estuary CSO Treatment Facility, Somerville Marginal CSO Pretreatment Facility). At the treatment plants, samples are taken monthly for parameters not monitored daily by the plants, such as organics, metals and cyanide.

Beach sampling has been frequently requested in response to reports of odor problems and unidentified growths or discharges into the harbor.

Other monitoring activities include sampling soil or sludge to determine the degree of contamination to assist in proper disposal decisions, verification of discharges and connections via dye tests and researching sewer line maps, groundwater sampling, and sampling at construction or cleanup sites before discharge to the sanitary sewer system.

Municipal Permits/Sewer Use Discharge Permits

Sewer Use Discharge Permits are issued to each sewer user discharging industrial wastes located in the Authority Sewer District regardless of size, type or volume of discharge. For permitting purposes, the Sewerage Division has classified users into four categories according to the nature of their wastes. The categories are as follows:

1. Industries requiring pretreatment.
2. Industries having some toxic discharges but at concentrations which do not require pretreatment.
3. Industres which have non-toxic discharge in addition to sanitary flow.
4. Dry industries or industries with sanitary flow only.

Sewer Use Discharge Permits are revised as new information is received. At present, much of the activity involving permits is due to revisions and renewals, which are done on a daily basis.

Compliance and Enforcement

The Authority has been extremely successful in working with its Sewer Users in a cooperative spirit to eliminate existing or potential discharge problems, since the inception of the Industrial Waste Program. Over the years, thousands of industries and other sewer users have been inspected, monitored and issued permits. Through the inspection, monitoring and permit phases of the Water Quality Department's Industrial Waste Program, many of these industries were found to be in violation of acceptable discharge practices. Any continued violations of permit conditions or Sewer Use Rules and Regulations will result in enforcement actions to assure compliance with acceptable discharge practices. New Sewer Use Rules and Regulations promulgated May 1, 1987 have broadened the scope of MWRA enforcement powers, including rights to:

1. Issue an order to cease and desist any such discharge violations;

2. Direct a User to submit a detailed schedule, subject to such modifications as the Authority deems necessary, setting forth actions to be taken to correct or prevent a violation;

3. Issue an implementation schedule ordering specific actions and a time schedule;

4. Revoke, modify or deny a permit issued to the User by the Authority;

5. Impose administrative penalties up to $10,000 per day of continued violation, and seek payment for damages to its system pursuant to 360 CMR 10.105 and 360 CMR 2.00;

6. Bring a civil or criminal action as provided by law;/ or

7. Take any other action available to it under federal, state or local law or regulation.

In cases where significant resistance is given to the Authority's discharge regulations, enforcement actions have been initiated. Enforcement actions to date range from informal meetings with the offending companies to legal actions taken through the Office of the Attorney General of the Commonwealth of Massachusetts. The results have been civil penalties ranging upward of $600,000 and agreements for judgements mandating adherence to strict compliance schedules.

The Authority's newly promulgated Administrative Penalty Regulations and Rules for Adjudicatory Proceedings will enable the Water Quality Department to be more effective in enforcement. The Authority is also establishing firmer policy and procedures which will be followed for the imposition of Civil Penalties in those future cases which require the assessment of fines.

3.3.3 TREATMENT PLANT UPGRADE PROGRAMS

Both the existing Deer Island and Nut Island Treatment Plants are being upgraded to extend the useful life of the installed facilities until the new treatment facilities can be constructed and placed into operation.

The Nut Island Immediate Upgrade Project began in January, 1983 and is expected to be completed in May, 1988. Eight projects costing approximately $12 million have been initiated to extend the useful life of the Nut Island Plant approximately ten years. Table 3.3.3-1 summarizes the eight immediate upgrade projects. Table 3.3.3-1 also describes other projects that are planned or underway to rehabilitate the existing treatment plant.

The Deer Island Treatment Plant Fast Track Improvementss Program consists of several projects to raise the operating efficiency of the existing plant to an acceptable level. The construction of these upgrading projects started in June, 1986 and is expected to be completed in March, 1990. The Deer Island Fast Track Improvements Program is summarized in Table 3.3.3-2. Other projects that are expected to improve the service life of the existing facilities on Deer Island are also described in Table 3.3.3-2. These rehabilitation projects also include upgrading the remote headworks facilities which function as an integral part of the Deer Island Treatment Facilities.

TABLE 3.3.3-1
NUT ISLAND IMMEDIATE UPGRADE

o Power

- Rebuilding of one engine generator
- Installation of 2000 kw transformer for purchased off-site power to the site

o Preliminary Treatment

- Addition of influent flow meter (sonic type) on the High Level Sewer
- Installation of new ventilation system, odor control equipment, and explosion-proof electrical components to the grit facility
- Removal of comminutors downstream from the grit chambers
- Rebuilding of the effluent channels from the grit tanks
- Replacement of air header to the preaeration basins
- Rebuilding of one preaeration blower motor

o Primary Sedimentation

- Structural rebuilding of tanks and repairing of leaks
- Levelling of tank floors
- Replacement of all weirs
- Replacement of sludge collection equipment

o Digesters

- Replacement of outside sludge piping from the primary sludge pumps to the anaerobic digesters
- Digester roof rehabilitation

o Outfalls

- Installation of an automated sluice gate at the outfall
- Cleaning of the two main outfalls

o Electrical Distribution Substation Replacement

o Sewerage Pump Switchgear Replacement

TABLE 3.3.3-2

DEER ISLAND TREATMENT FACILITY
FAST TRACK IMPROVEMENTS

- o Pump Station and Power Station Improvements
  - 5 new 90 mgd influent sewage pumps
  - 4 new 2000 Hp electric motors
  - New graphic control center to monitor sewage flow
  - New cooling water system for engines
  - New pumps for process water building
  - New heating system process water building
  - 2 new 6000 kw dual fuel, engine/generator sets
  - New switch gear/electrical distribution center
  - New fuel storage system for engines
- o Rehabilitation of Digesters
  - 4 new floating roofs
  - New internal digester piping
  - New gas meters at each digester
  - New waste gas burners with meters
  - 6 new spiral heat exchangers
  - 4 new sludge hot water pumps
  - 1 new boiler
  - Rehabilitation of 2 Ingersoll-Rand gas compressors
  - A new heating and ventilating system for both the sludge thickener and the digester complexes
  - A gas detection system for both complexes
- o Sludge Thickener Improvements
  - Remove existing tank mechanisms
  - Remove existing bridges, pumps and associated piping
  - Install new thickener mechanisms and bridges
  - Install new sludge transfer system, pumps and compressors
  - Install associated piping, electrical and control instrumentation
- o Primary Sedimentation Basins Improvements
  - New grit collection system
  - New grit classification building
  - New scum concentration building

Table 3.3.3-2 (cont'd)

- New chemical feed building
- Influent and effluent sampling stations
- 80 new motorized influent sluice gates and 80 stainless steel baffles
- New flow splitter plate, to equalize grit distribution
- Structural repairs to the sedimentation basins and bridges
- 48 new stainless steel aeration leaders and diffusers
- 3 new air compressors for the aeration channels

o Chlorine Rehabilitation

- 8 new evaporators
- 8 new chlorinators
- 2 new scale systems
- New HVAC system
- New roof
- New piping and distribution system for chlorine and process water

o Electrical Upgrade

- 4 new electrical distribution substations
- New conduit for substations
- New motor control centers throughout Deer Island

o Dual Fuel/Generator Overhaul

- Overhaul of 5 diesel enginers 1000 Hp
- Overhaul of 4-700 kw generators

o Deer Island Remote Headworks Improvements
(Columbus Park, Chelsea Creek and Ward Street)

- New grit collection and removal equipment for all 12 channels (four at each facility)
- New climber-type mechanical screens
- New HVAC equipment
- New odor control equipment
- Improvements to electrical systems
- Monorails, hoists and bridge cranes
- Hydraulic power units for sluice gates

o Winthrop Terminal Headworks Improvements

- Three climber-type mechanically cleaned bar screens
- Grit collection equipment

Table 3.3.3-2 (cont'd)

- Three inlet sluice gate operators and hydraulic power system
- Overhaul six sewage pumps (4-16,000 gpm and 2-32,000 gpm)
- Six new drive motors and controls
- Screening discharge enclosure
- Two stair access/egress towers

3.3.4 INTERIM RESIDUALS MANAGEMENT PROGRAM

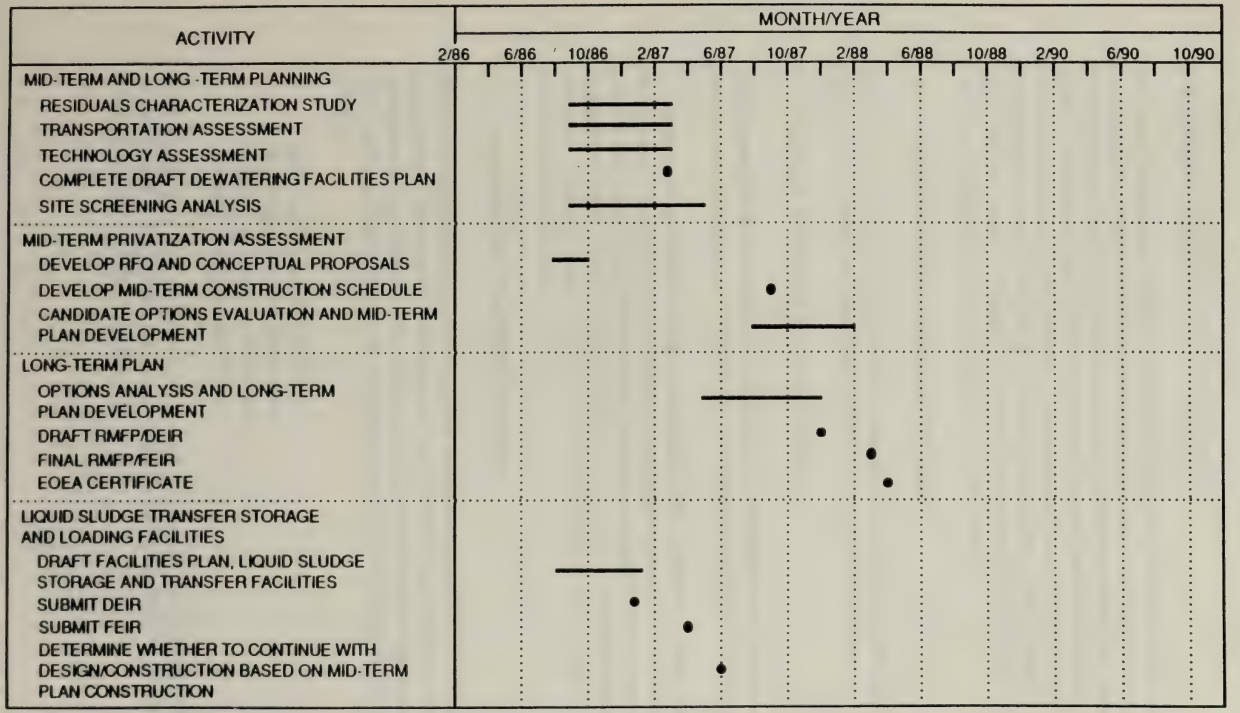
The Interim Residuals Management Program is intended to provide the facilities necessary to cease the discharge of sludge to the ocean by 1991. MWRA is presently soliciting proposals from private firms to provide land based disposal of sludge until the long term management facilities now being planned are constructed in 1995. The Interim Residuals Management Program includes sludge from both the Deer Island and the Nut Island Treatment Plants.

A second component of the Interim Residuals Management Plan is interim scum management. Scum is the floatable material that is skimmed from the surface of sedimentation facilities at both treatment plants. Scum is currently mixed with the sludge and discharged to the Harbor. Because these materials are the more obnoxious and visible discharge to the Harbor, the removal of these materials has been given the highest of priorities. For the interim period at Nut Island, scum screening, chemical conditioning and landfill disposal was selected as the recommended scum handling option. Design of these facilities was initiated in May, 1987. At Deer Island, the recommended plan for termination of scum discharges involves a one year demonstration project. This project includes chemical fixation of all Deer Island scum by a private contractor with storage on-island. Initiation of this period is anticipated in November, 1987. At the end of the one year demonstration, a decision will be made to build permanent facilities or to continue with a service contract.

A third component of the interim residuals management plan is a composting pilot plant. Composting stabilizes organic materials and destroys bacteria and viruses in sludge. Composted sludge has the potential for use as a soil supplement for production of turf grass, horticultural uses at green houses, use as a low-grade fertilizer or use as a landfill cover material. The pilot plant was initiated in 1984 and currently processes fifteen dry tons per day of sludge. The pilot plant serves the dual purpose of reducing the quantity of sludge discharged to the harbor and at the same time provides a compost product to test and develop a market for the material in the greater Boston area. The compost pilot also provides valuable information for the assessment of the viability of composting as a long-term residuals management option.

3.3.5 LONG-TERM RESIDUALS MANAGEMENT FACILITIES PLAN

The facilities planning for the long term management of residual solids is being conducted concurrently with this planning effort. The planning effort includes assessment of the quantity and quality of Deer Island and Nut Island sludge, survey of available sludge processing and transport technologies, selection of appropriate technologies, screening of potential disposal sites and selection of optimum facilities and sites. Design and construction will include both on-island and mainland facilities. The facilities planning is scheduled for completion in 1988. Figure 3.3.5-1 illustrates the general flow of planning activities for the residuals management facilities plan.



MASSACHUSETTS WATER RESOURCES AUTHORITY

FIGURE 3.3.5-1
RESIDUALS MANAGEMENT PROJECT SCHEDULE

3.3.6 WATER TRANSPORTATION FACILITIES

The Water Transportation Program includes the construction of the piers and related facilities to move materials, workers and equipment to and from Deer Island for the construction of the new treatment facilities and at Nut Island to support construction of the new headworks facility. Facilities planning for both on-island and on-shore piers is essentially complete. On-island piers are now being designed. Construction of these essential facilities is expected to commence in March, 1988 and be completed in September, 1989. Construction of the on-shore piers is expected to start in September, 1988 and be completed in May, 1990. See Figure 3.3.6-1 for a schedule of water transportation facilities planning.

3.3.7 COMBINED SEWER OVERFLOW PROGRAM

MWRA is currently evaluating a means of abating pollution from combined sewer overflows. Figure 3.3.7-1 denotes the overall facilities planning for the CSO program.

3.3.8 HARBOR RESEARCH AND MONITORING

The ultimate goal of this project is the design and implementation of a plan for action directed towards cleaning up Boston Harbor and protecting the Harbor in the future.

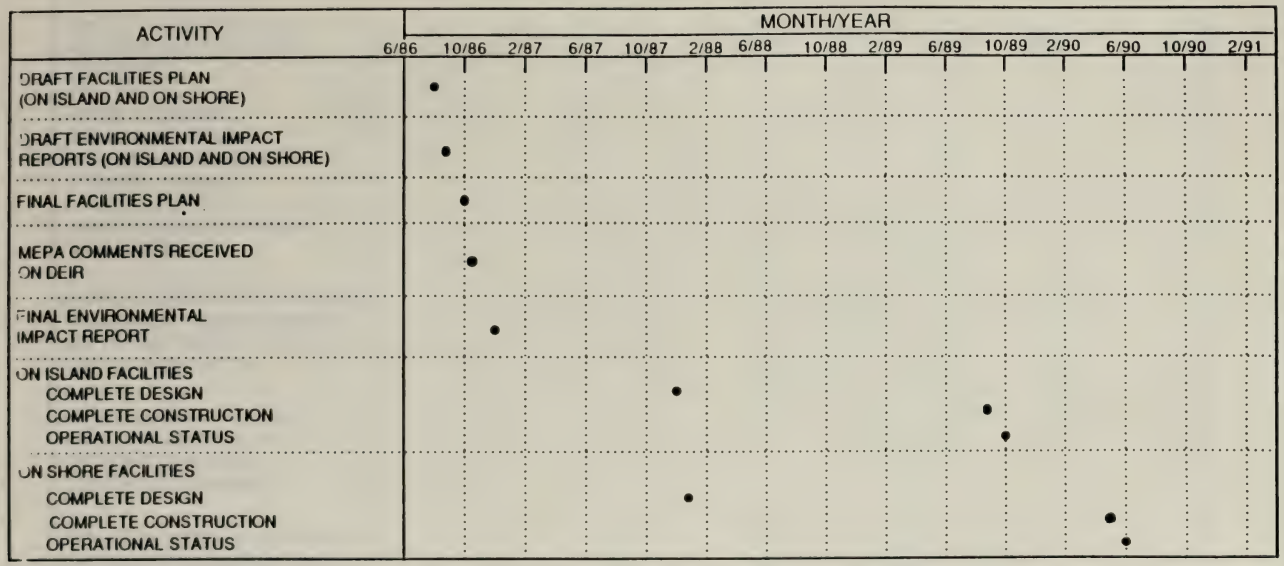
A Technical Advisory Group (TAG), established in 1986, produced a "Study Plan for Basinwide Management of the Boston Harbor/Massachusetts Bay Ecosystem". This plan defined the goals for research and monitoring in Boston Harbor and Massachusetts Bay that will be closely tied to management issues. The study plan further identified many issues facing environmental managers. Of these issues, five have been identified as high priority, requiring a well-focused scientific study.

3.3.9 WASTEWATER TRANSPORT PROGRAM

MWRA member communities discharge their wastewater through 1825 connections and 5400 miles of local sewers to 228 miles of MWRA sewers and 10 MWRA pump stations. In 1976, the EMMA study recommended approximately $1.7 billion in improvements to sewers through the year 2000. Since 1976, the sewer relief program has informally taken on a definition involving four major projects:

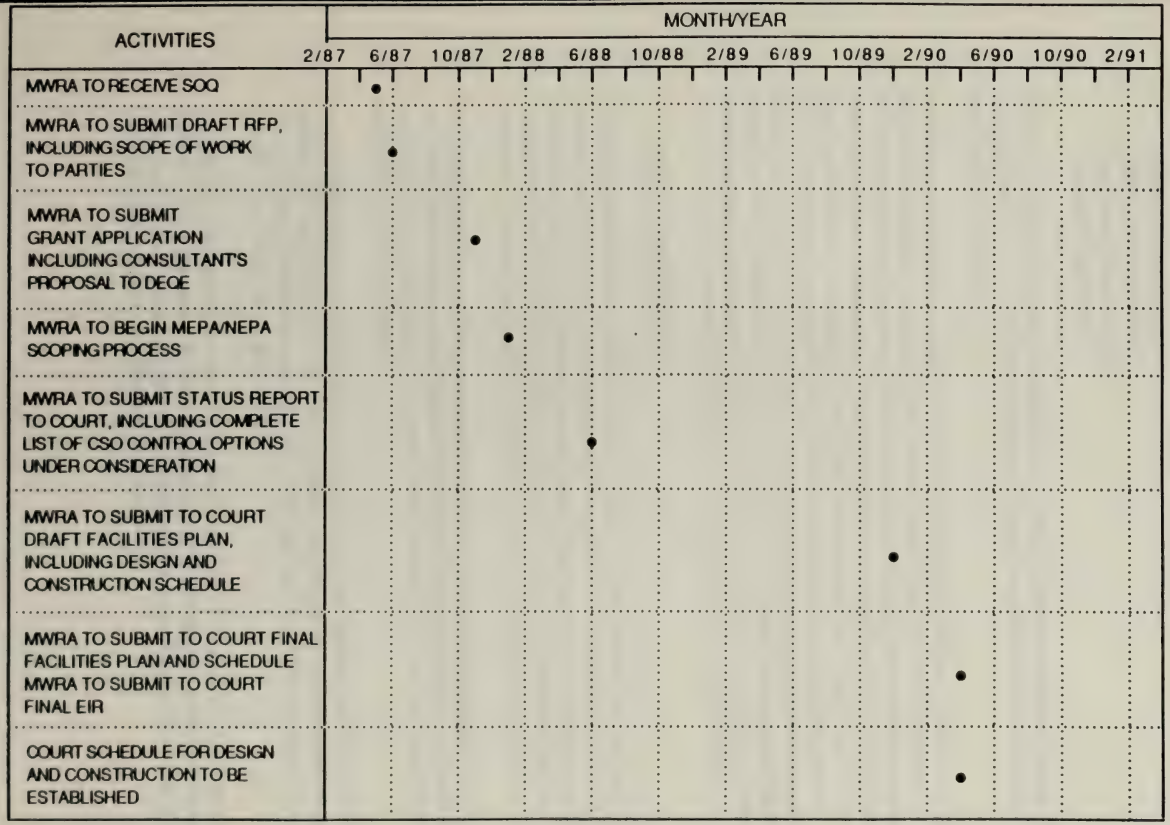
Braintree-Weymouth Relief Sewer
New Neponset Valley Relief Sewer
Framingham Extension Relief Sewer
Wellesley Extension Relief Sewer

Progress has been slow on the four major projects due to the complex and controversial nature of each project. The MWRA has, however, demonstrated success with the following projects either under construction or completed:



MASSACHUSETTS WATER RESOURCES AUTHORITY

FIGURE 3.3.6-1
WATER TRANSPORTATION FACILITIES PROJECT SCHEDULE


ACTIVITIES
MONTH/YEAR
2/87
6/87
10/87
2/88
6/88
10/88
2/89
6/89
10/89
2/90
6/90
10/90
2/91
MWRA TO RECEIVE SOQ
MWRA TO SUBMIT DRAFT RFP, INCLUDING SCOPE OF WORK TO PARTIES
MWRA TO SUBMIT GRANT APPLICATION INCLUDING CONSULTANT'S PROPOSAL TO DEQE
MWRA TO BEGIN MEPA/NEPA SCOPING PROCESS
MWRA TO SUBMIT STATUS REPORT TO COURT, INCLUDING COMPLETE LIST OF CSO CONTROL OPTIONS UNDER CONSIDERATION
MWRA TO SUBMIT TO COURT DRAFT FACILITIES PLAN, INCLUDING DESIGN AND CONSTRUCTION SCHEDULE
MWRA TO SUBMIT TO COURT FINAL FACILITIES PLAN AND SCHEDULE
MWRA TO SUBMIT TO COURT FINAL EIR
COURT SCHEDULE FOR DESIGN AND CONSTRUCTION TO BE ESTABLISHED

MASSACHUSETTS WATER RESOURCES AUTHORITY

FIGURE 3.3.7-1
COMBINED SEWER OVERFLOWS
PROJECT SCHEDULE

Millbrook Valley Relief Sewer
Reading Pumping Station
Reading Extension Sewer
East Boston Pumping Station
Hingham Force Main

The Water Transport Program is moving forward, with the potential downstream impacts of the utmost concern. The Southern System Modeling Project, which is now underway, is the first major step in this process.

MWRA plans to participate in a joint public and private effort to establish a Harbor monitoring and research program. The program will conduct research that will report on existing conditions and measure incremental change as the residuals management program and treatment plant upgrading are implemented. The priority areas to be studied include: (1) sources and fate of contaminants; (2) effects of contaminants and the health of the living resources; (3) nutrient enrichment; (4) economic, legal, political and social science assessment and; (5) public health impact. The study of these areas requires both short term projects designed to answer particular questions and a monitoring program that will determine long term impacts of human activities on the marine ecosystem. The technical results produced by these studies should be used in multiple-use management endeavors conducted by several agencies.

3.4 PROJECT MILESTONES

Though pollution of Boston Harbor has been a matter of public concern since the late 1960's, awareness was heightened in December of 1982 when the City of Quincy filed a lawsuit against the Metropolitan District Commission and the Boston Water and Sewer Commission (BWSC). Quincy sought relief from the pollution of Quincy Bay, which it claimed was resulting from the discharges of untreated and partially treated sewage from Nut Island and Moon Island.

As a result of this suit and the recommendations of the court-appointed special master, a bill was filed to remove sewer responsibilities from the MDC and to place them in a financially and organizationally independent public authority. On December 19, 1984, the Massachusetts Water Resources Authority was created.

On the following day, the EPA announced its intention to take additional action to help secure a harbor cleanup and brought suit in federal court, requesting a set of deadlines for pollution control projects. Filed at the end of January, 1985, the suit named four defendants: the MDC, the MWRA the state and the BWSC.

As a result of this lawsuit, on May 8, 1986 the United States District Court of Massachusetts imposed "major milestones" as long-term target dates to assist facilities planners toward the completion of primary and secondary treatment facilities. These dates are as follows, with milestone dates relating to this facilities plan in bold type:

Design and Construction of Piers and Staging Areas and Facilities Planning

On-Island

a. Complete Design	12/87
b. Bid Construction	5/88
c. Award Construction	8/88
d. Complete Construction	9/89
e. Attain Operational Status	6/90

On-Shore

a. Complete Design	1/88
b. Bid Construction	6/88
c. Award Construction	9/88
d. Complete Construction	5/90
e. Attain Operational Status	6/90

Facilities Planning

a. Project Start	**5/86**
b. File ENF (s) (see appendix F of this volume)	**6/86**
c. Complete Draft Facilities Plan	**9/87**
d. Complete Draft EIR	**11/87**
e. Complete Final Facilities Plan	**12/87**
f. Complete FEIR	**2/88**
g. Complete Environmental Review	**4/88**
h. Accept Facilities Plan	**5/88**

Construction of Treatment Plant, Outfall, and Inter-Island Wastewater Conveyance System

a. Initiate construction of new primary treatment facilities	12/90
b. Complete construction and commence operation of new primary treatment facilities	7/95
c. Initiate construction of outfall	7/91
d. Complete construction of outfall	7/94
e. Initiate construction of inter-island wastewater conveyance	4/91
f. Complete construction of inter-island wastewater conveyance	12/94
g. Initiate construction of secondary treatment facilities	during 1995
h. Complete construction of secondary treatment facilities	during 1999

The 1986 Court order allows for the re-examination of these long-term target dates for the completion of this Facilities Plan.

Section 4

4.0 BASIS OF INSTITUTIONAL PLAN

4.1 OBJECTIVES

The objective of Volume VII, Institutional Considerations, is to review the target dates for completion of construction as entered by the federal court and recommend any changes needed in the target dates based upon the facilities planning efforts, and to identify the permitting, program management, financing, human resources and regulatory requirements for constructing and operating the recommended facilities within the schedule. The document is intended to serve as an implementation plan for those responsible for constructing, financing, and operating the proposed facilities.

4.2 RECOMMENDED FACILITIES PLAN

The recommended plan for the MWRA treatment facilities consists of the following major components:

Preliminary Treatment

- Screening and grit removal at existing North System remote headworks.
- Screening at Winthrop Terminal.
- Additional grit removal of North System flow at new grit facilities on Deer Island.
- Screening and grit removal of South System flow at new Nut Island headworks.

Wastewater Pumping

- Replacement and modification of existing pumps at the North Main Pumping Station and the Winthrop Terminal to allow discharge to the new treatment facilities.
- Pumping of the South System flow at a new South System Pumping Station on Deer Island.

Primary and Secondary Treatment

- Primary treatment to a flow rate of 1270 mgd in stacked rectangular clarifiers arranged in four batteries.
- Secondary treatment to a flow rate of 1080 mgd in four parallel batteries of sequentially arranged anaerobic selectors, aeration basins and stacked rectangular clarifiers.
- Oxygen generation with two 300 ton per day cryogenic units.
- Fine screening of primary effluent in excess of 1080 mgd with traveling water screens.

Disinfection

- Disinfection with barge-delivered sodium hypochlorite in chlorine contact basins, with dechlorination, if required, accomplished using sodium metabisulfite.

The sequence of treatment is presented schematically in Figure 4.2-1.

All of the treatment units except the secondary clarifiers and disinfection contact basins will be covered. Exhaust air from the covered treatment units, and from pumping station wet wells and wet shafts, will be collected and treated with wet scrubbers (using sodium hypochlorite and caustic soda) followed by carbon adsorption.

During treatment of the wastewaters, residuals, including screenings, skimmings, grit, primary sludge, and secondary sludge, will be produced. Removal points from the treatment facilities are indicated in the treatment schematic shown in Figure 4.2-1. Handling, treatment, and disposal of these residuals is being addressed in the MWRA's Residuals Management Facilities Plan. Projected average quantities of residuals are presented below.

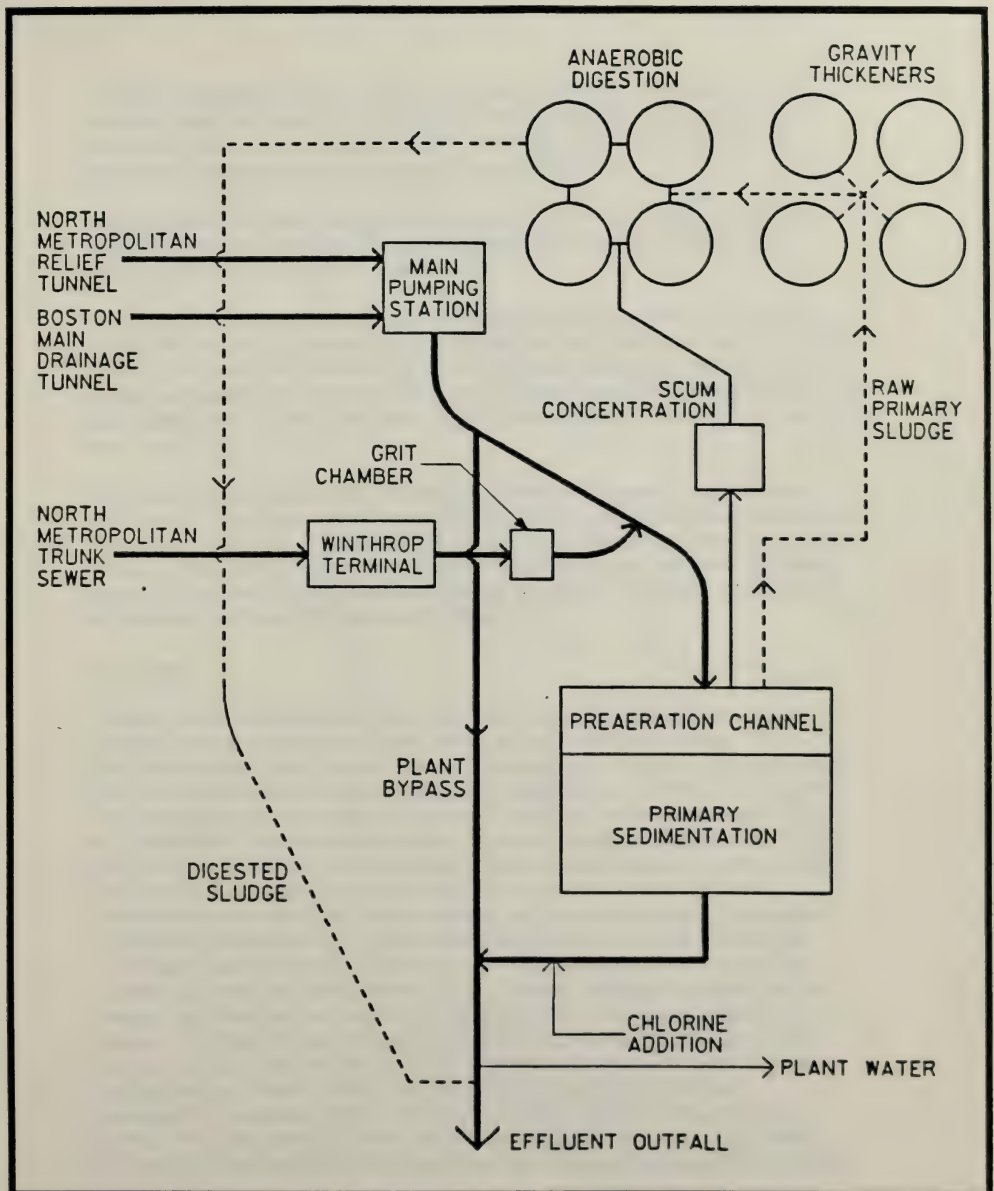
SUMMARY OF AVERAGE RESIDUAL PRODUCTION

	Remote Headworks	Deer Island	Nut Island
Grit (cubic yards per day)	4 to 6	30 to 32	11
Screening (cubic yards per day)	14	2	11
Skimmings (cubic yards per day)	--	70	--
Primary Sludge (dry tons per day)	--	168	--
Secondary Sludge (dry tons per day)	--	140	--

4.2.1 SITE LAYOUTS

Nut Island

The recommended layout for the new Nut Island headworks locates the facility at the site presently occupied by the existing anaerobic digesters. The site will be available once the MWRA's interim solids disposal program is in place by 1991. The headworks facility consists of a headworks building and grit removal facilities. The most visible component of the facility will be the headworks building which houses the screening facilities, truck loading bays, air emissions control facilities, administrative, operation, employee and maintenance areas. This building covers approximately 19,000 ft^2 and is 20 ft high. The existing grade at the selected site is approximately 131 ft while the final grade at the site will be approximately 128 ft. The grit chambers are located below grade, adjacent to the headworks building, and cover an overall area of approximately 22,000 ft^2. The inter-island tunnel shaft is located to the south of the grit chambers.



MASSACHUSETTS WATER RESOURCES AUTHORITY

FIGURE 4.2-1
DEER ISLAND
WASTEWATER TREATMENT PLANT
SCHEMATIC

Access to the headworks facility is by either the existing main access road along the western side of the island, or the pier to be constructed at the northeast end of the island. The roadways on the island are arranged to provide safe traffic patterns for all vehicles, and allow fluid movement of the trucks serving the headworks facility.

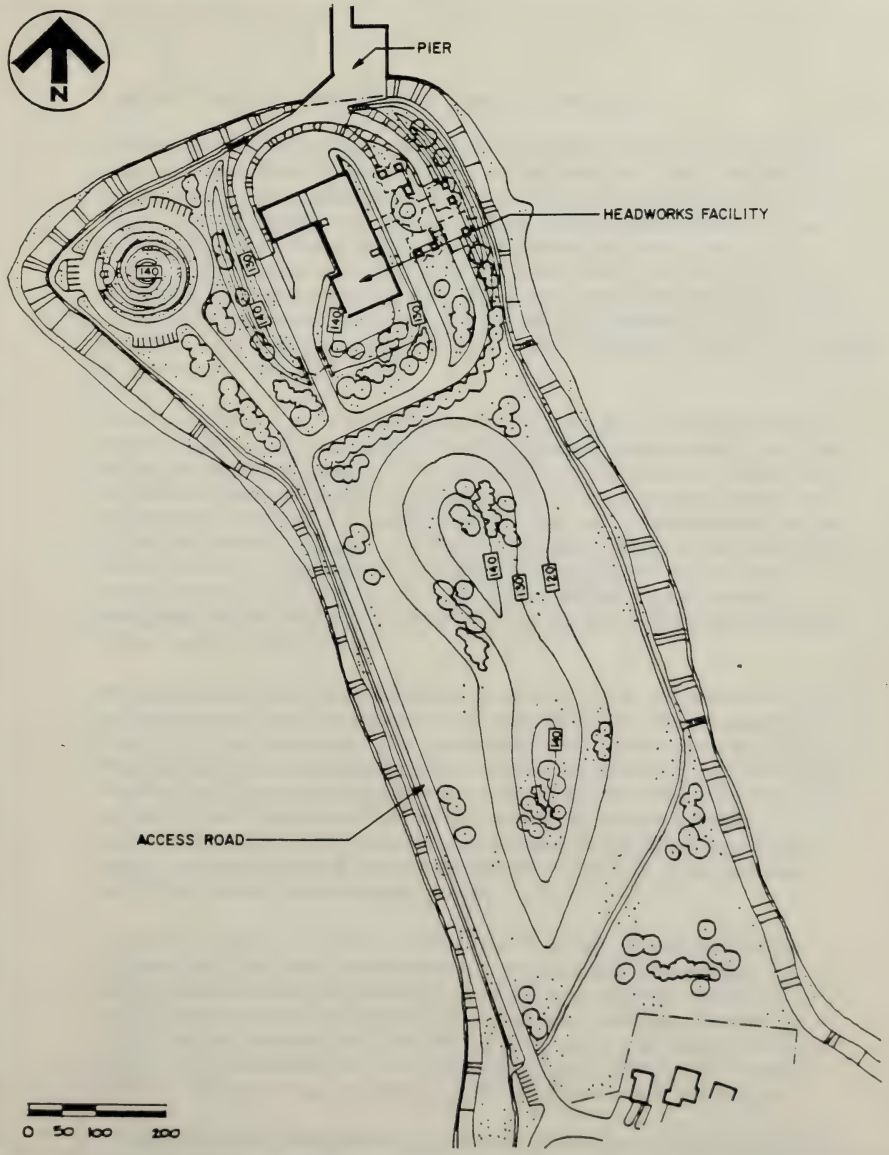
The site plan for Nut Island allows for safe, shared use for wastewater treatment and passive recreation. Areas designated for wastewater treatment facilities are separated from the remainder of the island by fences and earth berms.

The portions of the site that have not been designated for wastewater treatment purposes are planned as open space for passive recreation. Landforms and vegetation on the island promote this use. This concept is consistent with the City of Quincy's land use zoning classification. A pedestrian path encircles the island, providing continuous views of Boston Harbor and Quincy and Hingham Bays, as well as convenient access to most of the island including the beach on the eastern shore.

Proposed landscaping on the island is functional, while at the same time creating a natural visual image. Earth berms up to elevation 140 ft are formed around and against the wall of the headworks building and grit chambers. The berms, trees and shrubs are arranged to visually screen the headworks facilities -- primarily from Hough's Neck, but also from points across Quincy Bay and from the pedestrian path encircling the island. An architectural site plan of the developed Nut Island site is presented in Figure 4.2.1-1.

Deer Island

The Deer Island site plan consists of four interrelated parts - the buffering landforms, the treatment facilities, the support facilities, and the residual management facilities. These parts are tied together by an external access system consisting of roadways, piers, and service roads and an internal access system consisting of passageways, pipe galleries, and stairwells. Each of the parts has its own distinct visual image - the landforms are gently sloped earthen and vegetated hills, and the treatment facilities are large massings of concrete basins. These parts have been assembled so that the concrete treatment facilities occupy the central portion of the site, the brick faced support facilities occupy the adjacent area on the western, southern and eastern side of the treatment facilities, and the landforms occupy the outermost portion of the site and effectively conceal the treatment facilities and support facilities on the northern, eastern and western sides of the site. The appearance of the recommended facilities to a viewer will depend upon the viewer's location. Within the landform areas on the outer edge of the site, the visual image will generally be of the earthen vegetated hillsides. This image will also be seen by distant viewers, particularly those to the north and east of the site. The view from the external access roadway located between the western landforms and the treatment facilities will be of the brick faced support facilities backdropped by the concrete walls of the basins, with earth landforms rising around the horizon. From the treatment facilities, the view will consist of a large expanse of covered and uncovered basins surrounded by support buildings which are backdropped by the earthen



MASSACHUSETTS WATER RESOURCES AUTHORITY

FIGURE 4.2.1-1
NUT ISLAND SITE PLAN

landforms. The recommended site layout is shown in Figure 4.2.1-2.

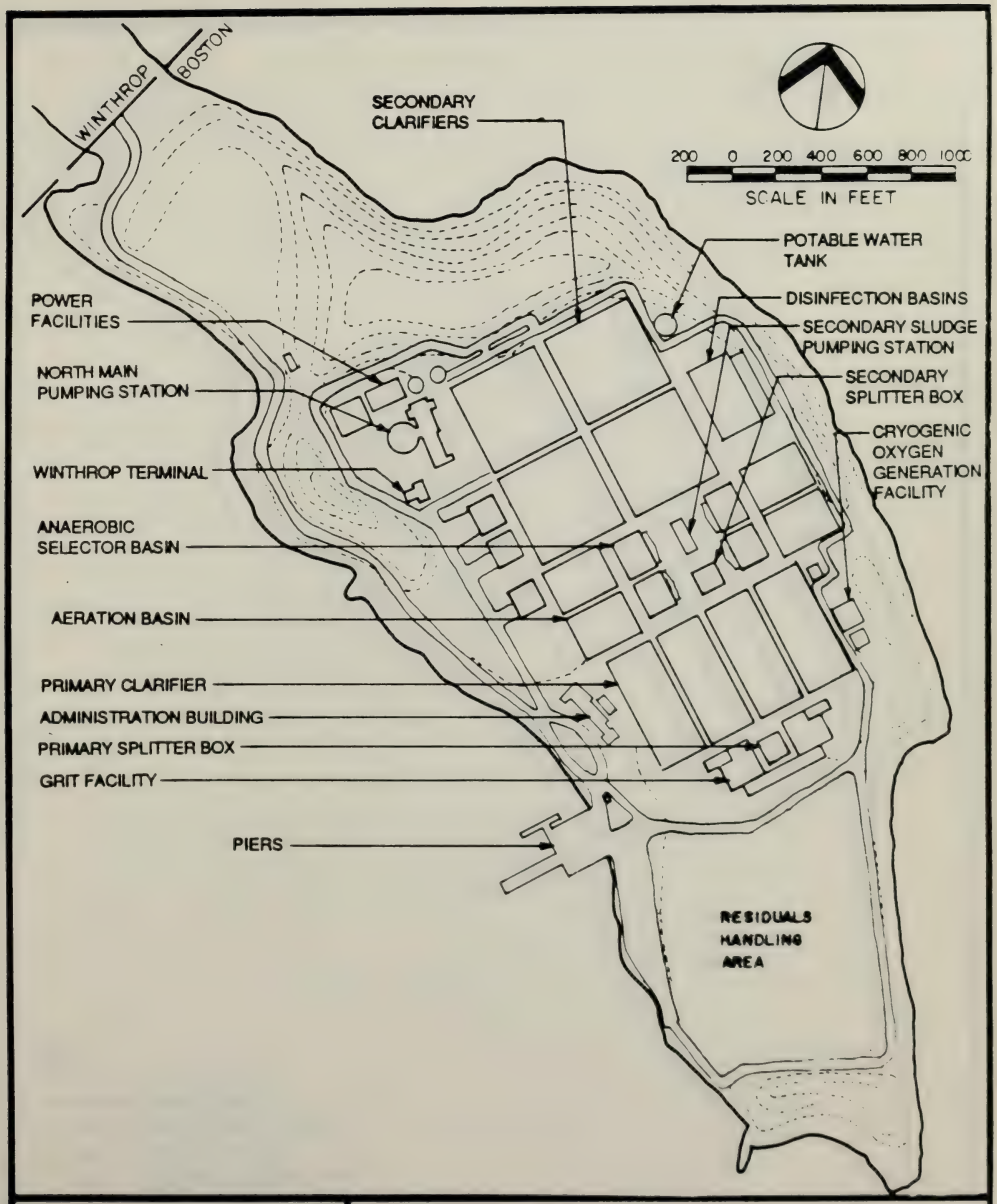
Vertically, the design of the site is organized around two distinct zones. The lower/access zone is at an approximate elevation of 120 to 130 ft and is the level at which the piers, access roadways, internal passageways, and the ground floor of the support buildings are located. The upper/facilities zone at elevations 145 to 155 ft is the level at which the tops of basins, air emission control facilities, operation buildings, and service roadways are located. Within the facilities, air emission exhaust stacks, potable water storage tank, oxygen plant distillation columns, and power plant exhaust stacks create vertical spikes rising to elevations between approximately 200 to 230 ft. Around the facilities the landforms rise to elevations ranging from approximately 180 to 220 ft and are connected by ridges with elevations of approximately 150 ft.

The main process area of the liquid treatment facilities is aligned in a rectangular grid on a generally south-to-north axis, extending from approximately the southern edge of the existing drumlin and proceeding northward to the area currently occupied by the Hill Prison structure. The southern portion of the main process area consists of primary treatment facilities, the central portion is dedicated to the anaerobic selector basins and the aeration basins, and the northern end consists of the secondary clarifiers. The plant is subdivided within each of the primary and secondary treatment areas into four equal sized batteries, with each of the batteries containing multiple basins. Residuals handling facilities (per the Residuals Management Facilities Plan) will be located in the area between the liquid treatment facilities and the southern tip of the island.

The support facilities have been located along the western, southern and eastern side of the plan as independent, brick faced structures with either connecting tunnels, passageways, or bridges to the main treatment structure. The majority of the support facilities including the power facilities, North Main Pumping Station, maintenance, warehousing, administration and laboratory operations have been located along the western side of the treatment facilities. On the southern side of the treatment facilities have been located the primary facilities operations management center, the grit handling facilities, and the South System Pumping Station. On the eastern side of the treatment facilities are located the oxygen generation plant and the primary effluent screening structure.

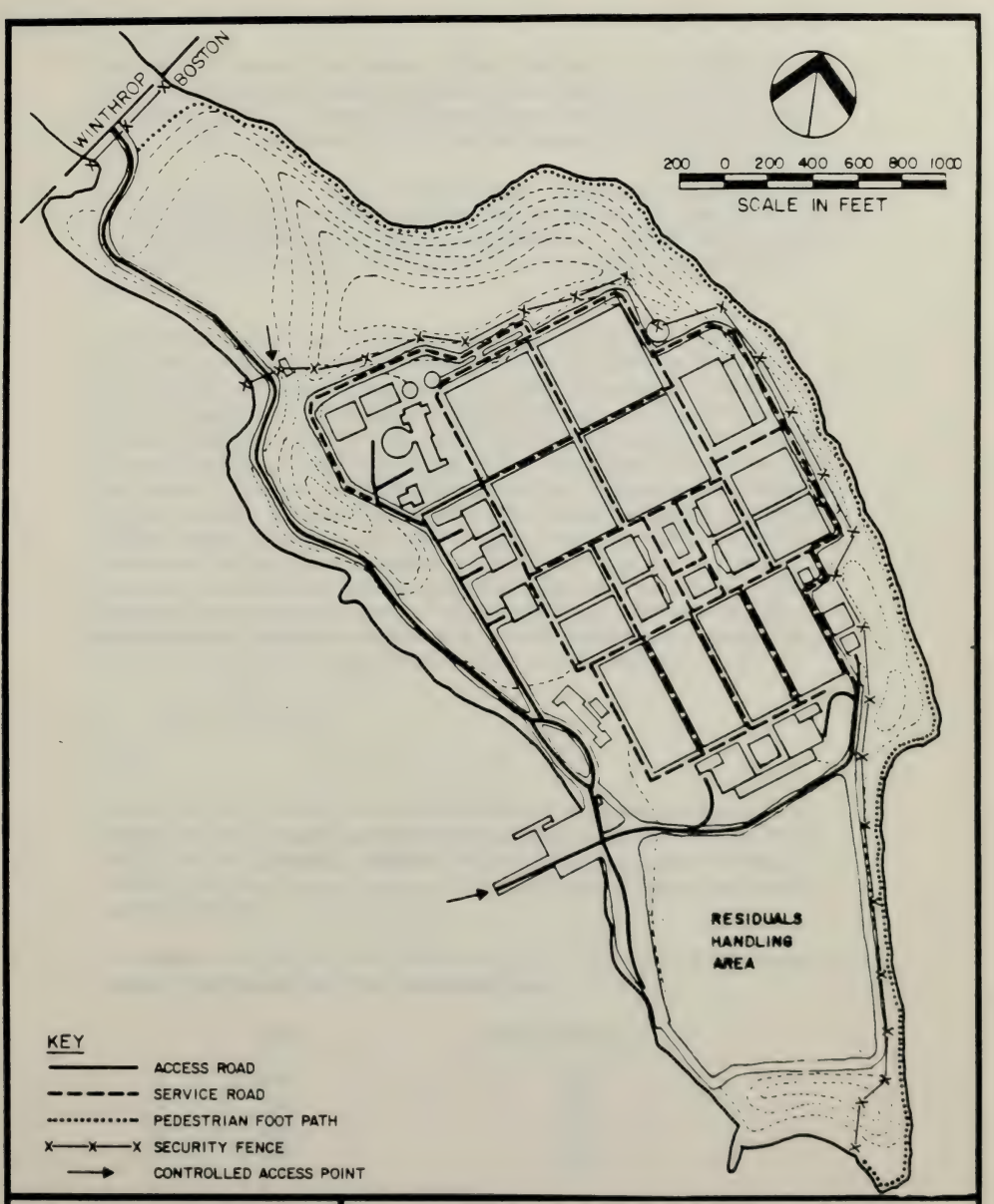
As shown in Figure 4.2.1-3, access to Deer Island will be both overwater and overland. Overwater traffic will unload and be controlled at the proposed new pier facilities. A vehicular access road along the western side of the treatment facility will connect the pier to the administration building, the treatment facility lower zone, maintenance facilities, and residual facilities. The vehicular access road will be ramped up to the northern end of the facilities, and on the western side at the maintenance buildings adjacent to the secondary clarifiers. The service roads completely surround and access the upper facilities zone.

An overland vehicular access road will connect Point Shirley to Deer Island. This road will have controlled access at two points. One of the control points will be a fenced gate at the property line, adjacent to Point Shirley and the northernmost outer berm. The second control



MASSACHUSETTS WATER RESOURCES AUTHORITY

FIGURE 4.2.1-2
RECOMMENDED DEER ISLAND FACILITIES



MASSACHUSETTS WATER RESOURCES AUTHORITY

FIGURE 4.2.1-3
DEER ISLAND EXTERNAL ACCESS

point will be the entrance to the treatment facilities at the inner limit of the separation zone. This overland access roadway follows the western shoreline to the area of the administration building. This roadway alignment directs visitors from the overland access routes to the same common point, the administration building, as the overwater access routes.

Within the separation zone, north and east of the plant, construction of a pedestrian footpath is contemplated. It would commence at the northern gate near the man-made drumlin and follow the northeastern shoreline of Deer Island to its southernmost tip. A control fence located at the inland foot of the landforms will prevent pedestrians from entering into the treatment plant areas.

The internal circulation system for the lower/access zone is as shown on Figure 4.2.1-4. Within the treatment facilities are numerous pipe galleries that have been configured to provide the plant with connected passageways between the various process elements. The main internal passageway runs from the pier area northward through the treatment facility. Main east-west passageways run at right angles to the north-south passageways in three locations: the east-west passageway between the primary clarifiers and aeration basins connects to the administration building and the primary effluent screening building; the east-west passageway between the aeration basins and the secondary clarifiers connects the vehicle maintenance building, secondary operations center, return activated sludge pump station, and plant water pump station; and the east-west passageway between the batteries of secondary clarifiers connects the maintenance and parts storage facilities to the internal access system. Minor passageways and pipe galleries would be located between process batteries as necessary for equipment access. Egress and ventilation shafts from the passageways are typically located at the ends and midpoints of the primary and secondary clarifiers batteries.

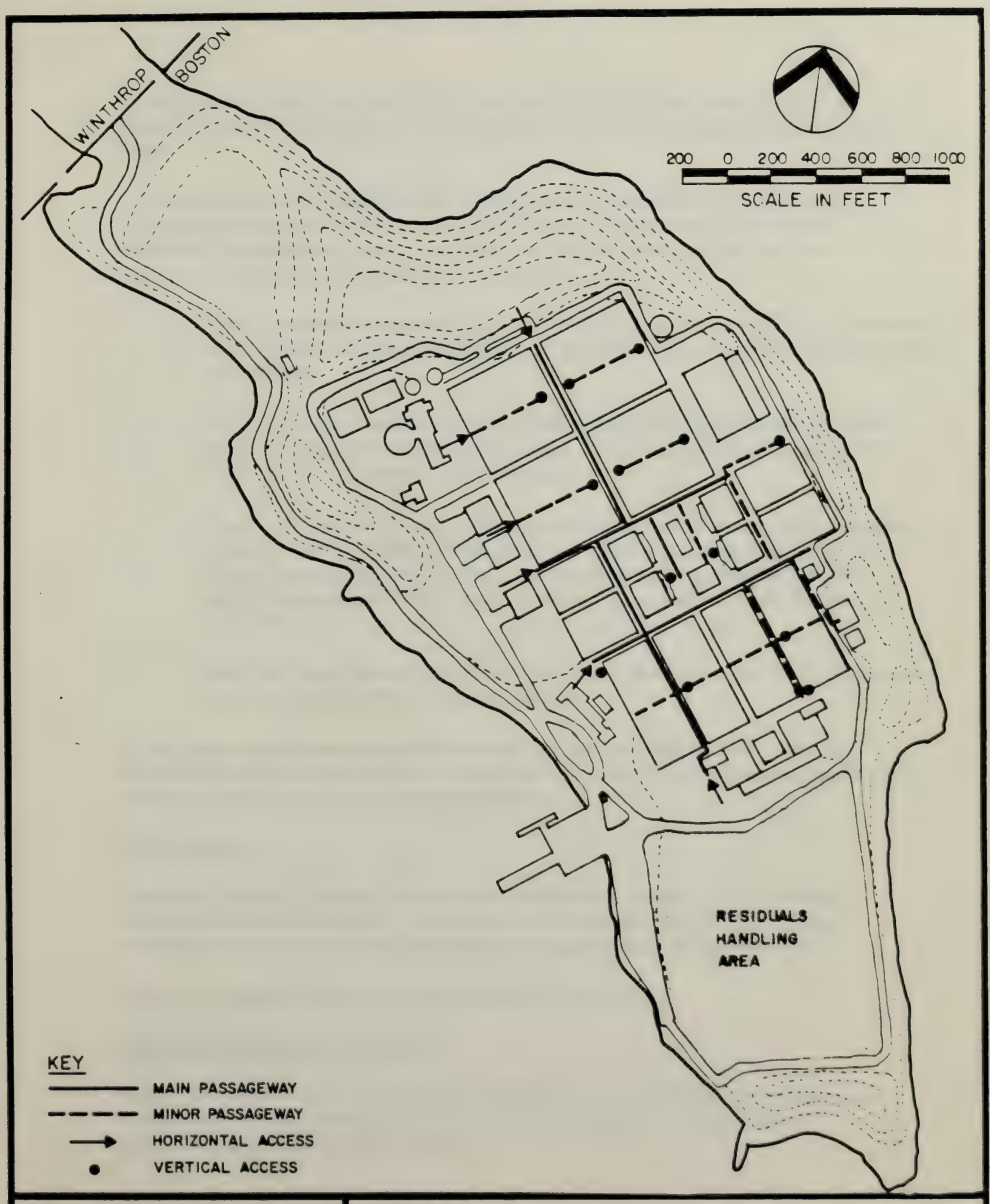
4.2.2 PLANT UTILITIES

Power

Currently no public electrical utility services the Deer Island wastewater treatment facility. All electrical energy presently required at Deer Island is generated on-site by five, 700 kw diesel engine driven generators. Additional deisel engine-driven generators are being installed as part of the fast-track improvements to meet present day demands and should be operational by 1988.

The estimated average electric power requirements for the various phases of construction and operation of the treatment facility are summarized below:

Year	Average Load (kw)
1990	14650
1991	18650
1995	24050
1999	36800



MASSACHUSETTS WATER RESOURCES AUTHORITY

FIGURE 4.2.1-4
DEER ISLAND INTERNAL ACCESS

To meet these demands a combination of on-site generation and off-site supply from Boston Edison Company (BECo) were evaluated using technical, economic, and environmental evaluation criteria.

The recommendation to provide sufficient, reliable power to Deer Island in all phases of construction and operation consists of the installation of a temporary power supply cable, followed by the installation of two 115 kv feeder cables and a combined cycle power plant. A summary of the recommended power plan is as follows:

- Install a temporary power supply cable by 1990 or sooner. Provide 15 Mw of immediate power through Massachusetts Electric Company (MECo) from its Metcalf Square Substation in Winthrop.

- Install a 115 kv permanent feeder from Boston Edison's K Street substation in South Boston, by January 1992. Placing the feeder in service requires the installation of a 115 kv to 13.8 kv substation on Deer Island.

- Install an on-island 25,700 kw combined cycle power plant by January 1995 to provide additional capacity for peak shaving and provide protection against catastrophic failure of the off-site power sources. This additional capacity combined with the soon-to-be-installed fast track capacity, will result in an installed on-site capacity of 37,700 kw.

- Install the second Boston Edison 115 kv permanent feeder by January 1995. This feeder will originate from BECo's Chelsea substation.

On-site sludge digestion and its associated costs and benefits are being studied as part of the Residuals Management Facilities Plan. On-site digestion would produce methane gas which can be used as a fuel in the on-site power generation facilities.

Heating Demand

The heating demand at the Deer Island treatment facilities will increase as new wastewater treatment facilities are constructed. The expected total yearly heat load, based on seasonal steam demand per degree days, has been estimated at approximately 86,000 million Btu.

Heat will be extracted as steam from the combined cycle power plant.

Potable Water and Plant Water System

Potable water needs for the new Deer Island wastewater treatment facilities were estimated and contrasted with existing water availability, and alternative approaches to support Deer Island's water supply needs were evaluated.

Potable water is presently used at the wastewater treatment facility for toilets, sinks, drinking fountains, sludge heaters, engine cooling, equipment flushing and washdown, and seal water. This water is supplied from the Winthrop water distribution system. Current average and maximum consumption rates are 0.1 mgd and 0.2 mgd, respectively. Water use will increase when the plant is upgraded to an average daily consumption of 1.0 mgd and a maximum daily consumption of 2.0 mgd.

Potable water required by the new Deer Island facilities cannot be supplied through Winthrop's existing distribution system due to the limitations in the system. A water supply study concluded that Deer Island potable water needs are best met by constructing a dedicated 20-in-diameter main through Winthrop to Deer Island.

The recommended plan provides for a 1.54 million gallon on-site storage of potable water at Deer Island in order to dampen the effects of diurnal flowrate variations, to provide adequate pressure for firefighting, and to provide a source of water in the event of a break in the dedicated main.

In order to minimize the consumption of potable water, the recommended Deer Island facilities are designed to reuse primary and/or secondary effluent for those purposes which do not require potable quality water. Non-potable water is designated "plant water", and will be used as necessary for engine cooling, process equipment flushing and equipment washdown. Plant water will be provided by a 45 mgd (31,250 gpm) plant water pumping station discharging directly to the plant water distribution system.

4.2.3 ESTIMATED COSTS

Capital Cost

The estimated project cost for the recommended treatment facilities is approximately $1.325 billion dollars. These costs include the inter-island conveyance tunnel from Nut Island to Deer Island and the South System Pumping Station. Costs for the effluent outfall facilities and residuals handling facilities, however, are not included. The breakdown of the estimated costs is as follows:

	Cost in Millions
Nut Island Headworks and Site Restoration	$38
Inter-Island Tunnel	84
South System Pumping Station	40
North Main Pumping Station, Winthrop Terminal and North Grit Removal Facilities	71
Primary Treatment Facilities	241
Secondary Treatment Facilities	551
Disinfection Facilities	22

Power Generation and Distribution	103
Site Work	109
Potable and Plant Water Systems	19
Administration, Maintenance and Control Buildings and Facilities	47
TOTAL	$1,325

These costs reflect September 1987 prices (ENR cost index of 4440) and include capital construction costs plus an allowance of 35% for engineering and contingencies.

Operation and Maintenance Costs

The annual operating cost following completion of all the recommended facilities in the year 2000 is estimated to be $32 million dollars.

The annual estimated operating costs for 1995, when only the primary treatment facilities are on-line, are $23 million. These costs reflect September 1987 prices. Operation and Maintenance costs for residuals handling are not included.

4.2.4 CONSTRUCTION CONSIDERATIONS AND SCHEDULE

Maintenance of Plant Operations

The existing treatment facilities on Nut Island and Deer Island must remain operational during the construction of the new facilities, until the new primary treatment facilities on Deer Island are completed and ready for service.

The existing Nut Island treatment facilities, except for the anaerobic digesters, will remain fully operational while the new headworks facilities are being constructed. The anaerobic digesters will be removed from service and demolished once the Nut Island interim solids disposal facilities are operational by December, 1991. The new headworks facilities will be constructed on the site of the existing digesters, with minimal interference with the operations of the Nut Island treatment facilities. Following completion of the new Deer Island primary treatment facilities and the inter-island transport system, the new headworks will be connnected to the High Level Sewer. Once the new primary facilities on Deer Island are operational and ready to receive flows from the South System, the existing Nut Island treatment facilities will be decommissioned.

The new Deer Island primary treatment facilities will be constructed to the south of the existing primary facilities at the southern edge of the existing drumlin. The existing primary treatment facilities will remain in use until the new primary treatment facilities are operational. At that time, the existing facilities will be decommissioned. The new secondary facilities will be constructed in the area of the existing Deer Island plant. During construction of the new primary facilities, connections will be made to the North Main Pumping Station and the Winthrop Terminal that will allow these facilities to discharge to either the

existing primary or to new primary treatment facilities. These connections will allow controlled flows to the new facilities during startup and testing. Construction of the connections to the North Main Pumping Station will result in reduced pumping capacity (5 of 10 pumps available) for several days or a few months depending upon the selected plan for making the connections. The plan with the shorter duration will cost in excess of an additional three million dollars. Construction of the connection from the Winthrop Terminal will result in the pumping capacity being reduced from 125 mgd to between 90 and 95 mgd for about a 60-day period.

Construction Scheduling

The construction scheduling for the new treatment facilities is summmarized in this volume and presented in detail in Volume VII, Institutional Considerations. Construction of the recommended facilities will occur over the period from 1988-2000. The various components of the recommended plan will be constructed according to the following schedule:

o	Early site preparation	1988-1991
o	Immediate but Interim Power	1988-1990
o	Permanent Power	1988-1995
o	Nut Island Headworks, Inter-Island Conveyance System and South System Pumping Station	1990-1994
o	Primary treatment facilities	1991-1995
o	Phase 2 - Site Preparation	1991-1995
o	Secondary treatment facilities	1995-1999
o	Phase 3 - Site Preparation, including final landscaping and civil work	1995-2000

The construction plan based on the conceptual design information developed for the facilities plan represents an optimum means of achieving the goals set forth by the court-imposed cleanup schedule for Boston Harbor.

4.2.5 OPERATION AND MAINTENANCE ORGANIZATION

The new facilities will require a significant expansion in the number of staff, level of staff skills, and systems used to operate and maintain the MWRA's wastewater treatment system. To provide a realistic assessment of the numbers of staff and skill levels required, a suggested organizational format was developed in conjunction with the MWRA Sewerage Division and the Operations Review Committee convened for this facilities plan. The suggested organization consists of a decentralized or section concept with personnel assigned directly to a working section. Four major sections are suggested for the new teatment facilities: operations, maintenance, administration, and laboratory. This type of organizational concept is used at most of the large wastewater treatment facilities in this country. The objectives of the organizational structure include:

- Provide effective management and supervision of the large staff.

- o Guide the staff towards achievement of the Authority's objective of effective pollution control.
- o Direct staff to maintain high productivity.
- o Provide an efficient structure for information flow.
- o Provide support functions to operating staff.
- o Minimize operations and maintenance costs while attaining performance objectives.
- o Establish accountability through all staffing levels.
- o Provide career ladder for employees.

The hierarchy of the suggested structure is shown in Figure 4.2.5-1. Managers of the four organizational sections would report to the plant superintendent. Facilities included under the suggested organizational format include the three remote headworks on the North System, the Nut Island headworks, the new treatment facilities recommended for Deer Island, and the residuals management facities. The total estimated staffing requirement for the operation and maintenance of these facilities is 540 persons. This includes an allowance of 72 persons for operation/maintenance of residuals-related facilities. The actual staffing required for operation of residuals facilities will be determined by the Residuals Management Facilities Plan. This staffing is subdivided among the four sections as follows:

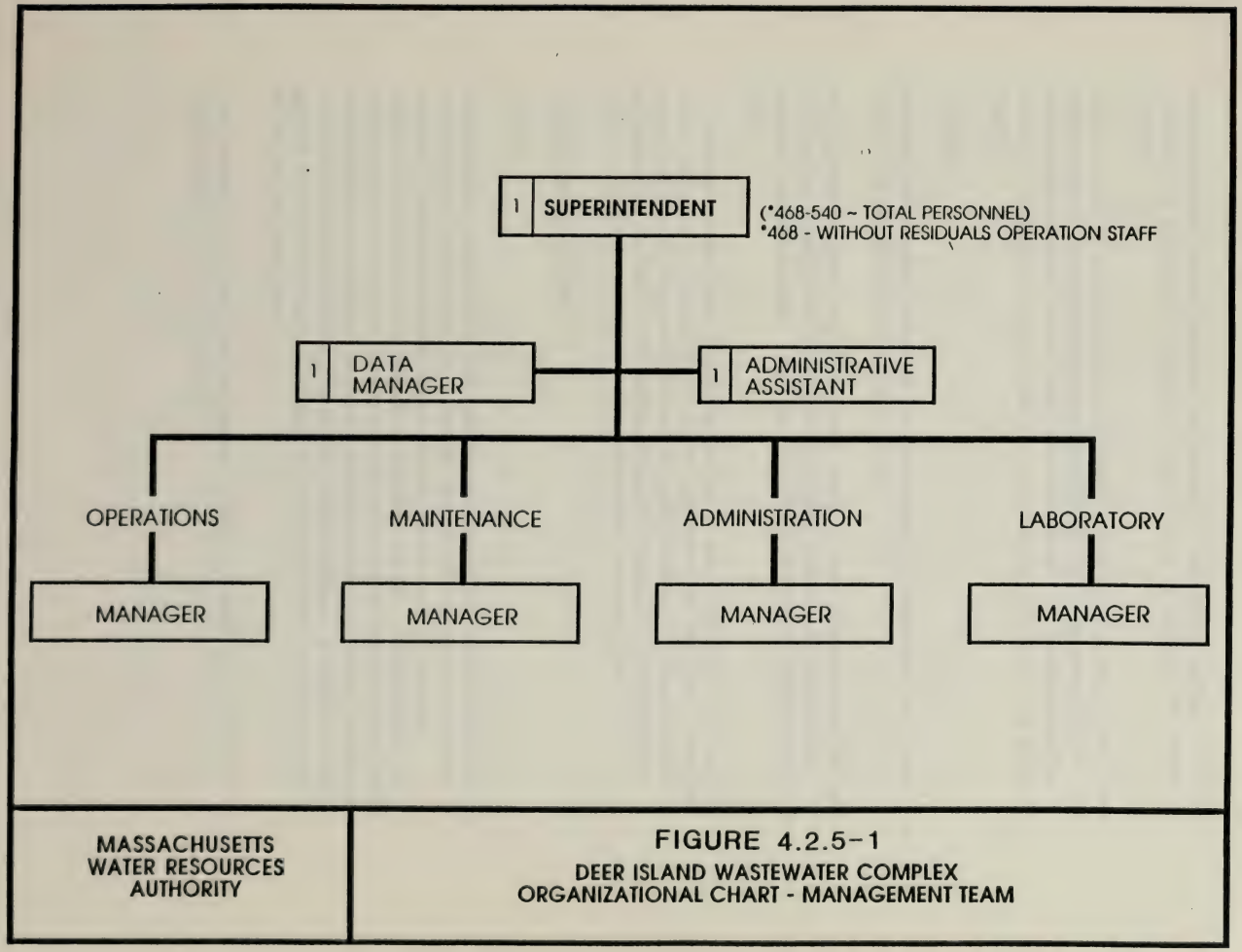
Administration	40
Maintenance	263 (275 with residuals facilities)
Operations	149 (209 with residuals facilities)
Laboratory	16

4.2.6 ENVIRONMENTAL CONSIDERATIONS

The environmental assessment of the treatment recommendations considers impacts on groundwater, air quality, land use and visual aspects, noise, terrestrial and aquatic ecology, and historic and archaeological resources on both Deer and Nut Island. Environmental impacts associated with the discharge of the treated secondary effluent through the ocean outfall are addressed in Volume V of this facilities plan.

Groundwater

Groundwater levels on Deer Island generally vary between elevations 108 and 114 ft. Since most



MASSACHUSETTS WATER RESOURCES AUTHORITY

FIGURE 4.2.5-1

DEER ISLAND WASTEWATER COMPLEX
ORGANIZATIONAL CHART - MANAGEMENT TEAM

construction activity at Deer Island and Nut Island will be well above groundwater levels, and no future use of groundwater is proposed at the new facilities, no impacts on this resource are expected.

A secure landfill will be located in the southernmost landform on Deer Island and will provide for the disposal of the grit and screenings presently buried south of the central drumlin. The landfill design will comply with the DWPC criteria for "sludge only" landfills and will use a double liner and leachate collection system to provide permanent protection for the groundwater resource.

Air Quality

The applicable air quality standards for the Commonwealth of Massachusetts are the same as the National Ambient Air Quality Standards (NAAQS).

The air quality impacts of the power and pump stations on Deer Island indicate that the 1995 power generating configuration would improve air quality in the area for all pollutants, compared to existing emissions, with the exception of TSP, which would remain essentially the same.

The proposed treatment system incorporates covering the treatment process units through the aeration basins and air emission controls will be operated such that even under a worst-case scenario, the impacts will be within allowable air quality limitations at all locations which are accessible to the public. At the more easily accessible locations (neighborhood sites adjacent to the facility), the impacts have been determined to be insignificant.

Land Use and Visual Impacts

Deer Island

Construction and operation of the new wastewater treatment facility on Deer Island will change land use on those portions of the island currently used for activities other than wastewater treatment. Upon completion of the construction activities at the turn of the century, virtually the whole island will be dedicated to wastewater treatment. Existing facilities will have been demolished (with the exception of historic structures identified for preservation and reuse), and earth movement will significantly change the profile of the island. Earthen berms will serve to separate the treatment plant and the Town of Winthrop. A large area of open space on the neck of the island and a footpath located along the eastern edge of the island will be open for public access.

Upon completion of the facility and landscaping, the island will appear more natural from most viewing locations than it does at present.

Nut Island

The construction of the new headworks on Nut Island should significantly improve the compatability of land use with abutting neighborhoods as well as provide a new area for passive recreational opportunities. The appearance of the site will be more natural, with landscaping and vegetation replacing the current concrete and asphalt surfaces.

Traffic

Transportation impacts resulting from the construction of the Deer Island Treatment Facilities will be minimal. Although large numbers of workers and quantities of construction materials will be required, half of the workers will be transported by ferry and the remainder will be transported by buses, using satellite facilities. With the exception of contingency trucking, all materials and equipment will be transported to Deer Island by barge.

Transportation impacts at Nut Island are being addressed in the on-island Water Transportation Facilities Planning FEIR.

Noise

Deer Island

Operation Noise. The new wastewater treatment facility on Deer Island will include equipment such as pumps, compressors, motor drives, a gas turbine, and an oxygen generation system, which have the potential to create audible off-site noise. An analysis was performed to identify the significant potential contributors to off-site noise, estimate their sound levels in Point Shirley, and select the appropriate noise mitigation required to minimize operations noise impacts.

To evaluate noise impacts from the facility, ambient noise levels were measured to serve as evaluation criteria. The levels found were 39 dBA nighttime and 45 dBA daytime. The noise evaluations have indicated that no noticeable increases above these evaluation criteria will be experienced during facility operation.

A considerable amount of the equipment will require noise attenuation. However, with the implementation of noise mitigation, the total sound level contribution of the facility at the nearest neighbor during nighttime hours is expected to be approximately 36 dBA, 3 dBA lower than the minimum ambient sound levels measured in 1986. Under the most favorable noise propagating conditions, a less than 2 dBA increase in existing ambient sound levels will occur. This change in ambient sound levels will not be noticeable.

Construction Noise. The construction of the facility will continue over a period of approximately twelve years, 1988 to 1999. During that time numerous buildings, treatment facilities and earthen landforms will be constructed, and the existing plant and prison will be demolished. The greatest potential for noise impact at Point Shirley will occur during the early stages of construction with the movement and placement of the earthen landform at the

northern end of Deer Island. Once constructed, this landform will serve to buffer the remainder of the construction noise.

The criteria of 39 dBA, nighttime, and 45 dBA, daytime, were also used to evaluate noise impacts from facility construction. Various mitigation strategies were employed to implement a noise control objective which would limit intrusive daytime construction noise to no more than 10 dBA over those ambient levels.

The most significant noise mitigating measure which will be utilized during construction is the placement of new landforms. The northern landform has been determined to be an effective noise barrier during construction, reducing noise perceived at Point Shirely by about 10 dBA eighty-three percent of the daytime. Maximum construction noise at Point Shirley will be approximately 50 to 54 dBA during upwind and cross-wind conditions, when the noise barrier is most effective. Approximately 17 percent of the time down-wind conditions limit the effectiveness of the noise barrier. Noise levels range between the low 50s to a maximum of 65 dBA under these worst-case conditions. Analysis of ambient noise monitoring data from Point Shirley has indicated that these projected, worst case impact noise levels are characteristic of the area and occur 97 percent of the daytime for about six minutes each hour. The projected construction noise levels are similar in magnitude to the existing daytime median or L_{50} levels, which range from 47 dBA to 63 dBA.

Nut Island

Operation Noise. The new grit and screening facility at Nut Island will be completely enclosed, with expected sound levels of less than 25 dBA at the nearest residential area. Since the daytime and nightime minimum ambient sound levels have been reported at about 50 dBA and estimated at 30 to 35 dBA, respectively, operation noise at the screenings facility will not be audible at the nearest residential area.

Construction Noise. The primary construction activities on Nut Island consist of the demolition of the existing facility, site preparation, and construction of the new building. The construction sound level is expected to be 63 dBA from 1992 to mid-1995, dropping to 60 dBA for the remaining year of construction.

Terrestrial and Aquatic Ecology

Sources of potential impacts on fauna and flora associated with the construction effort include: habitat removal and the subsequent displacement of fauna from cleared areas; the generation of fugitive dust; increased potential for erosion of cleared surfaces; construction generated noise; and the movement of construction personnel, equipment and materials on-site.

Land clearing is expected to have an adverse impact on the habitat of local wildlife species. However, none of the faunal species are endangered, threatened, or otherwise unique. The post-construction repopulation of the species on Deer Island is expected; thus the loss of these individuals does not constitute an impact of consequence.

The existing flora, primarily grass, is fairly resistant to impacts from fugitive dust. Dust control will be implemented through the use of water spray trucks to dampen exposed surfaces. No impact of dust on vegetation in adjacent communities is expected.

Erosion will be controlled through temporary stabilization of graded areas with seeding, tacking or mulching until permanent cover is established. The construction mitigation program will ensure that runoff from exposed surfaces will drain to settling basins, holding ponds, hay bale barriers and/or silt fences prior to discharge to the harbor.

Since the areas surrounding the construction zones presently do not support an appreciable number of wildlife species, no long-term deleterious impact from construction-related noise and movement of personnel, equipment and supplies is anticipated.

Few if any negative impacts on the terrestrial and aquatic ecology are anticipated from the construction and operation of the headworks on Nut Island.

Historic and Archaeological Resources

No historical or archaeological resources have been identified on Nut Island.

Historical and archaeological resources on Deer Island consist of the following:

- o Hill Prison
- o Prison Superintendent's House
- o Steam Pumping Station
- o Farmhouse
- o New Resthaven Cemetery

Consideration was given to potential preservation and reuse of these resources, compatible with the treatment facility site planning needs; impacts of site development on these resources; and proposed measures which would mitigate impacts on these resources.

The land requirements for the new secondary treatment facility use virtually all of the land on Deer Island and thus reduce the flexibility for planning reuse of historic structures.

Site planning evaluations have recommended that the Hill Prison and the Farmhouse be documented for the Historic American Building Survey and subsequently demolished. The Superintendent's House will be moved to a higher elevation and reused as a security center for the new treatment plant. The Steam Pumping Station, situated near the water where the proposed piers will be constructed, will be renovated and expanded for use as the administrative and laboratory functions. The Resthaven Cemetery will be left intact: the addition of 30 to 40 ft of fill material to the surface of the Cemetery will provide a mitigating noise and visual barrier, and will act as an appropriate preservation for the Cemetery.

4.2.7 INSTITUTIONAL CONSIDERATIONS

Training and Staff Development

The creation of a highly skilled treatment plant staff and the proper placement of trained staff throughout the entire organizational structure are the key elements to the successul operation of the proposed treatment facilities.

Staff must be procured in sufficient time for training prior to the scheduled startup of the treatment facilities. Training of the staff is of paramount importance in the effort to provide optimum operational efficiency in terms of plant effluent quality and operating costs, and to protect the enormous capital investment in pollution control facilities.

The new facilities will require that licensed operators be in charge of all shifts. To satisfy this requirement, the plant superintendent and the five shift supervisors must have Massachusetts Grade 7 certifications. In addition, the qualifications for various supervisory and staff positions should include an appropriate certification requirement. The completed secondary treatment facilities will require about 540 employees. This represents an increase of about 300 persons over the present level of employment. Approximately 80 of the estimated 540 staff positions could have certification requirements written into in the position qualifications.

The large number of licensed operators and certified staff included in the suggested Deer Island organizational scheme exceeds the existing supply in Massachusetts. The required Grade 7 operators for superintendent and shift supervisor positions can be filled by placement of existing staff and procurement of experienced, licensed personnel. However, in order to succeed in acquiring the total certified staffing, training programs will have to be implemented. Existing training programs in New England are not capable of providing the required numbers of licensed and certified staff. The recommended approach to satisfying staff training and certification requirements for the new facilities is through an on-site training program at Deer Island. All of the necessary training, with the possible exception of laboratory training, can be performed on-site. The training program should be developed, prepared, and delivered based on the equipment and facilities being placed into operation at Deer Island and the remote headworks.

The intricacies of the new MWRA treatment facilities and four remote headworks, coupled with additional unique conditions such as the location of the Deer Island facilities and concerns associated with transportation of workers to and from the site, the regional competition for skilled labor, and the local cost of living, compound the difficulties associated with staff procurement and development. These issues must be addressed by:

- Development of a procurement strategy that addresses the number of new hires required to staff the Deer Island facilities.

- Establishment of pay scales and benefit packages that will attract and retain qualified and skilled personnel.

- o Establishment of training and certification programs for the various staff levels.

- o Establishment of career ladders illustrating the advancement opportunities within the organization.

- o Identification of alternative means of commuting to the Deer Island site.

These issues must be addressed and resolved so that operations and maintenance staff will be in place for the startup of primary treatment facilities in 1995 and for the startup of the secondary facilities in 1999. A suggested procedure includes:

1. Adoption of an organizational structure for management/operation of the new facilities.

2. Preparation of complete position descriptions, including duties and qualifications, for each position in the organizational structure.

3. Adoption of salary schedules and benefit packages per position and grade.

4. Determination of staffing needs for startup and operation of the phased facilities.

5. Procurement and placement of staff. (This includes a review of qualifications and placement of the existing staff into the new organizational structure, and the hiring of new personnel.)

6. Development of programs to train the staff to operate the new facilities.

7. Training of personnel, phased as required to meet the needs of the new facilities.

4.3 INSTITUTIONAL FACTORS

The institutional factors discussed in this volume are intended to address the following questions:

- o What is the most realistic schedule for expeditiously constructing the wastewater treatment facilities?

- o What is the best approach for managing the design and construction of the multiple project components?

- o What funds are needed annually to construct the facilities and how will these requirements affect the rates of MWRA's customers?

- o What additional personnel requirements are generated by the operation of proposed facilities?

- o How have recent legislative and regulatory changes affected the construction and operation of the Deer Island Facilities Plan?

- o What legislative and regulatory changes will expedite the construction of the new facilities?

4.3.1 PROJECT SCHEDULE

On May 8, 1986, the United States Federal District Court set a schedule of target dates for the construction of the new sewage treatment facilities in Boston Harbor. In the Court's Order,

the Court noted clearly its intent to review the target dates upon completion of the facilities plan.

The general emphasis of the Court's continuing review was to "determine whether significant advancements (in the schedule) can be made." The court also provided direction on specific schedule-related issues that required examination during facilities planning. The results of these examinations will assist the Court in setting a revised schedule. The issues requiring study included:

- o The extent to which construction of the secondary treatment components of the plant can be reasonably overlapped with the construction of the primary treatment components;

- o The feasibility of completing a portion of the new primary treatment facility to accommodate either the North System or South System flows prior to the July 1995 date by which the new primary facility must commence operation;

- o The effects of accepting flows from the existing Deer Island and Nut Island facilities for discharge through the new outfall on the quality of water adjacent to the Town of Winthrop;

- o The development of a schedule for demolishing the existing Nut Island Plant based on the goal of ceasing operations within 6 months following initiation of treatment of the South System flows at the new Deer Island primary facility.

In addition to the technical evaluations required by the Court, the preparation of a project schedule also must include a realistic plan for obtaining permits and other regulatory agency approvals. The development of the permitting plan is based on (1) an analysis of potentially applicable laws and regulations and (2) an understanding of the procedures and schedules

associated with each permit and approval. This information becomes the basis for developing a coordinated permitting approach which eliminates duplication and promotes the timely implementation of the project. The scheduling requirements are then integrated into the master project schedule to insure sufficient time for complying with regulatory procedures.

4.3.2 PROGRAM MANAGEMENT REQUIREMENTS

In recognition of the difficulty of constructing the wastewater treatment facilities within the court-mandated schedule, the Court also directed that MWRA assess the use of "construction management." Construction management is one way in which MWRA could acquire the extraordinary program management skills needed to build its required facilities within the established aggressive timetable. The construction of the project's multiple components will require the careful coordination of numerous contractors, subcontractors, and material and equipment vendors. The coordination is complicated by the location of major project components on islands in Boston Harbor or underwater. Limited area is available for construction staging, and previous mitigation commitments require that bulk materials must be delivered by water transport. Therefore, the possibility of encountering "unforeseen" problems exists.

The analysis presented in this volume examines the services which can be provided by a program and construction manager (P/CM), reviews the advantages and disadvantages of using a P/CM and recommends alternative ways in which MWRA can obtain the necessary program management capability while retaining sufficient supervision of the expenditure of public funds.

4.3.3 FINANCING REQUIREMENTS

The construction of MWRA wastewater treatment facilities will be one of the largest projects of its type constructed in the United States. The facility, projected to cost in excess of one billion dollars, is being built at a time when the federal grant contributions for such facilities are diminishing rapidly. These grants will be phased-out entirely after June 30, 1990.

The annual cash flow required to build the facilities is analyzed carefully in this volume. The sensitivity of these requirements to changes in the construction schedule, level of grant receipts, interest rates, cost escalation rates and reserve requirements is also analyzed.

In addition to the cash flow requirements, the financial analysis includes an assessment of the facilities plan upon the rates of MWRA's customers in selected representative communities. This analysis, like the cash projections, examines the potential changes caused by alternative assumptions, most especially the varying levels of possible grant receipts.

4.3.4 HUMAN RESOURCES REQUIREMENTS

The successful operation and maintenance of the new treatment facilities, once constructed, will depend almost entirely on MWRA's ability to staff the facilities with knowledgeable, experienced and motivated staff.

The number of staff required, and the necessary diversity of their skills, will require MWRA to undertake several steps well in advance of facilities start-up to ensure that human resources are available when needed.

4.3.5 LEGISLATIVE AND REGULATORY ISSUES

Recently-enacted federal and state legislation can affect the financing and operation of MWRA's wastewater treatment facilities. The major legislative provisions affecting the financing of the facility are:

(1) 1987 Clean Water Act

- the reduction in appropriations for the Federal Construction Grants Program between now and FY 1990;
- the creation of a State Revolving Loan Fund capitalized with federal funds as the main mechanism for replacing the Construction Grant Program;

(2) 1984 MWRA Enabling Act

- the elimination of the state guarantee of MWRA borrowings after FY 1990;
- the existing $600 million cap on MWRA's borrowing capacity;
- the lack of clarity regarding the Authority's ability to use the private sector to assume simultaneous responsibilities for designing, building and/or operating any or all of MWRA's facilities - an approach labelled recently as "privatization"

(3) 1986 Tax Reform Act

- various provisions, including the inability to use arbitrage on tax exempt issues, which may increase the cost of tax exempt bonds.

In addition to legislative provisions affecting project financing, two regulatory provisions also will be examined:

- the EPA's announced intent to levy administrative penalties for schedule slippages by municipalities which have agreed to a clean-up schedule; and
- the proposed provisions regarding the management of residuals.

Section 5

5.0 PROJECT SCHEDULE

5.1 CONSTRUCTION PLAN

The construction plan and schedule for the recommended Deer Island secondary treatment facilities reflect the target schedule dates set forth by the MWRA's court-imposed clean-up schedule for Boston Harbor. To evaluate the continued feasibility of these court-imposed dates, the project construction activities are presented in a phased logic format that reflects the major construction packages necessary for the successful completion of the facilities. Constraints that are critical to the construction of the facilities are also identified.

The construction of the recommended facilities is to occur in the 1988-1999 period when several similar large-scale construction projects will also be in progress within the Boston metropolitan area. This competitive climate, which may result in a shortage of local skilled workers and an over-demand for some construction materials and equipment, could have a negative impact on the Deer Island project unless early actions are taken to mitigate these factors.

As one of these actions, it is recommended that the MWRA engage a Program and Construction Management team (P/CM) experienced in the construction of large-scale, complex projects. This CM should be employed by the MWRA during the early preliminary design phase of the treatment facilities. Such early involvement will provide the proposed MWRA Program Management Unit with the construction input needed to assist the design engineers in selecting equipment for pre-purchase; establishing construction contract limits with appropriate on-island laydown areas and haul road locations; identifying temporary utility needs; and reviewing the contract documents to ensure that constructibility needs are met while existing operations are maintained. The P/CM should also represent the MWRA in the necessary coordination efforts with the Central Artery/Third Harbor Tunnel construction project.

In addition, to ensure that the Deer Island project meets the scheduled completion dates within the project budget, the P/CM's responsibilities should include developing, overseeing, coordinating, monitoring, and administering all Deer Island secondary treatment facilities contracts relating to the following programs:

- Equipment Prepurchase
- Overwater Transportation
- Overland Transportation
- Concrete Production
- Construction Support
- Site Security
- Construction Innovations Analyses

The MWRA Board of Directors has directed that initial steps to obtain a Program and Construction Manager and Lead Engineer begin immediately. Section 6 of Volume VII describes more fully this proposed management approach for the recommended plan.

5.1.1 CONSTRUCTION SEQUENCING AND SCHEDULE

There are several key periods of construction for the Deer Island secondary treatment facility project: earth movement and landform construction efforts, 1990-1992; primary treatment facilities and tunnel construction, 1991-1995; and secondary treatment facilities construction, 1995-1999. During these periods, there are likely to be as many as sixteen general contractors, plus their subcontractors, working on Deer Island. Additional contractors will be working at Nut Island.

To facilitate the construction effort, a preliminary construction plan and schedule reflecting the target schedule dates set forth by the MWRA's court-imposed cleanup schedule for Boston Harbor have been developed. The following sections define this construction plan in terms of construction sequencing and schedule, preliminary construction packages, construction quantities, construction support efforts, and a recommended construction management approach. Prior to final design of the facilities, the Program and Construction Management team will develop a more definitive construction plan to aid the design and bidding process.

The logic of the construction schedule is based on the assumption that the Prison Facilities will be decommissioned in 1989 and that demolition of the Prison Facilities will occur no later than 1990. Should this not occur, the potential for delays during the 1990-93 construction period will increase.

The preliminary construction packages identified in the following section for the entire project and the major project constraints are logically scheduled using a computerized critical path method (CPM) program to establish the summary project construction schedule shown in Figure 5.1.1-1. The schedule reflects the court-imposed target schedule dates and incorporates the contracts expected to be awarded by the MWRA. The P/CM will coordinate the development bidding, award, and implementation of the construction contracts by monitoring the project schedule. Project progress will be reported against the approved schedule.

To expedite construction and allow for the early completion of partial treatment systems, construction activities for the primary and secondary plants are identified by process treatment zones as shown on Figure 5.1.1-2. The schedule identifies when primary and/or secondary treatment systems will be available by indicating when zones are completed.

Major plant construction activities are assumed to be scheduled to take place over two shifts per day, five days per week. Construction of the inter-island wastewater conveyance tunnel and the plant outfall will require that the work be done on a 24-hour-per-day, 6-days-per-week basis to meet the new primary treatment facility operation schedule. The plant outfall is assumed to be 5-9 miles long. The longer outfall poses the most difficult challange in maintaining the court-ordered schedule.

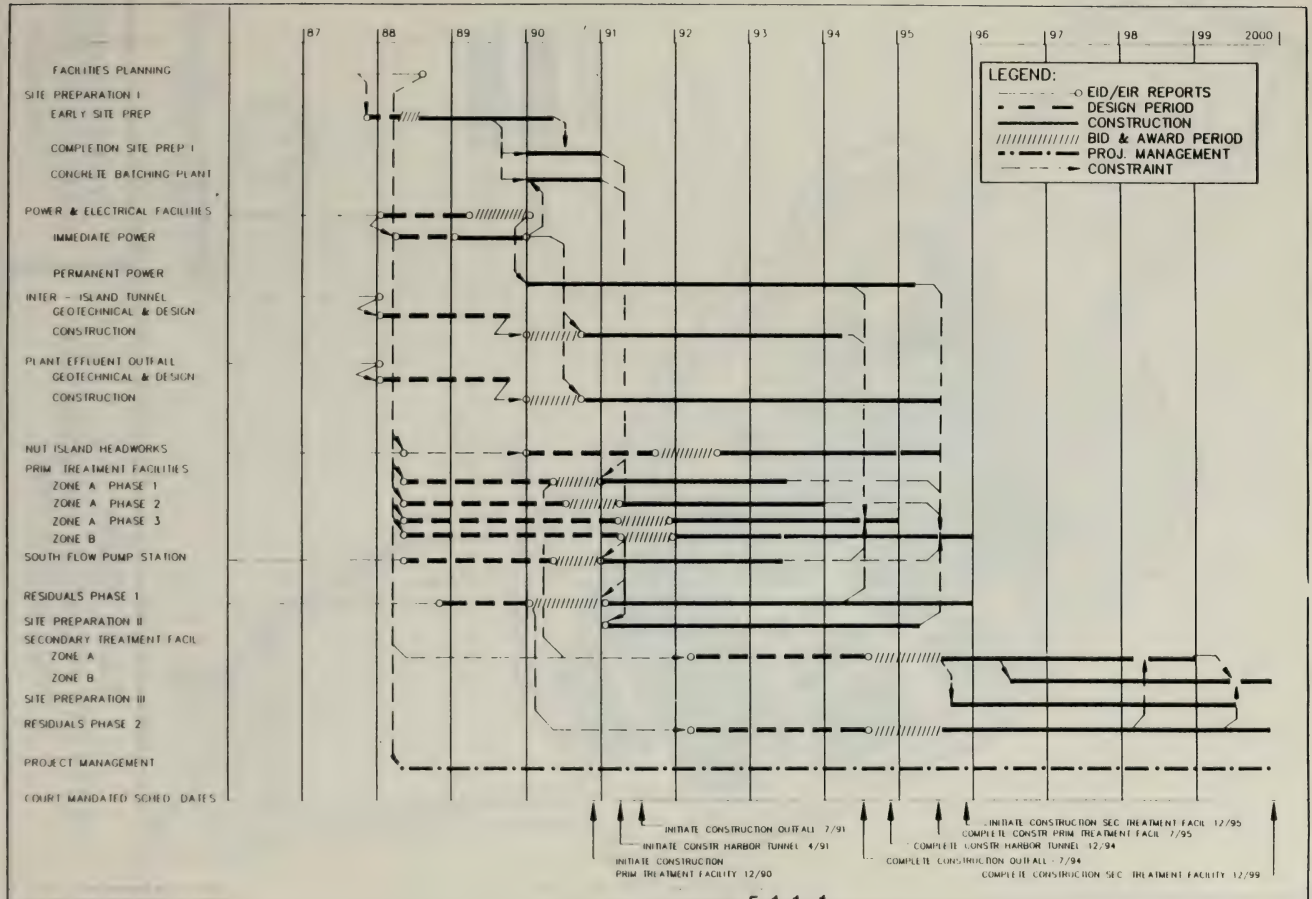


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FIGURE **5.1.1-1**
SUMMARY PROJECT CONSTRUCTION SCHEDULE

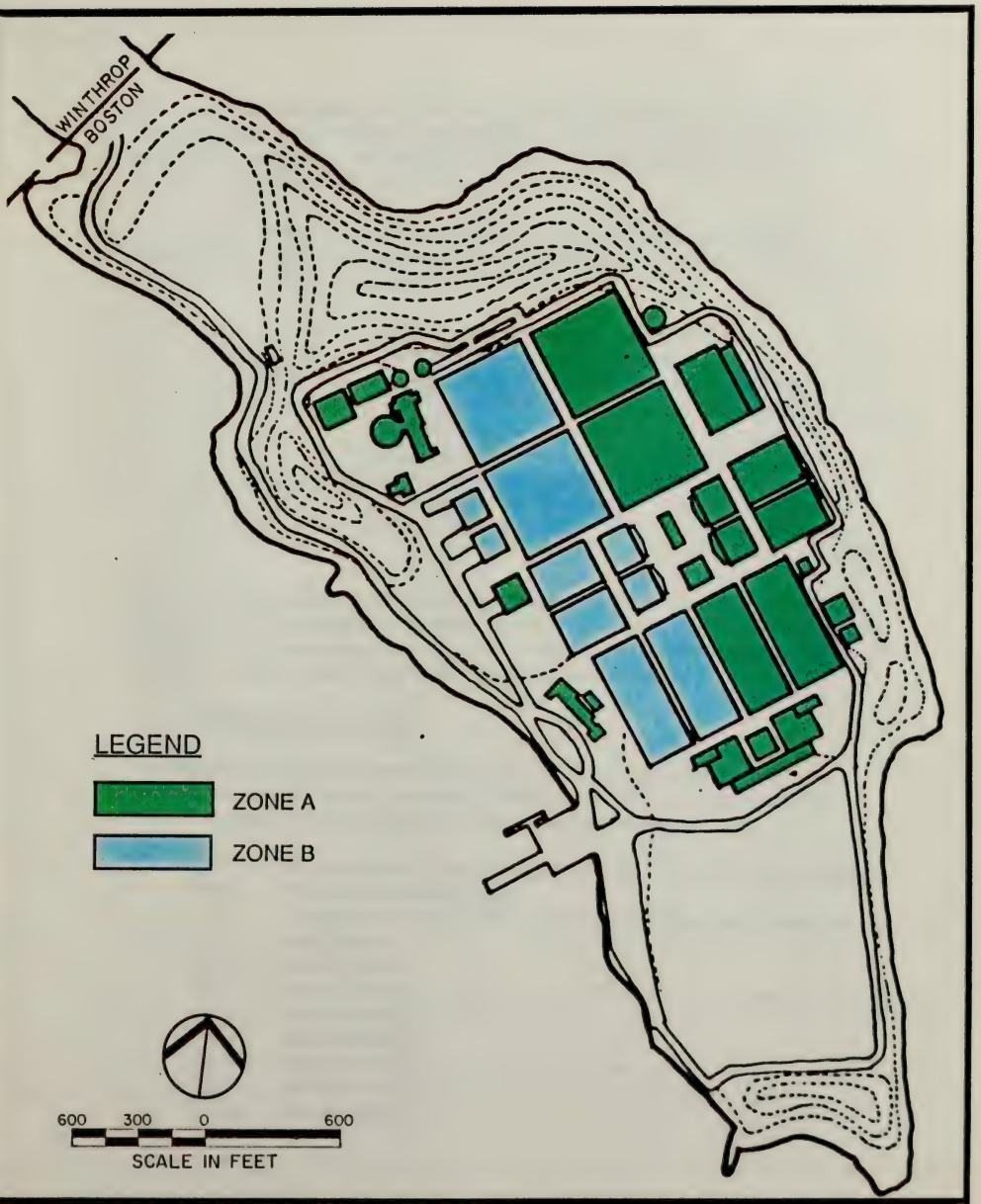

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FIGURE 5.1.1-2
WASTEWATER PROCESS TREATMENT ZONE A AND ZONE B

In order to ensure completion of the outfall tunnel by the July 1995 court-imposed date, it will be necessary for the MWRA to expedite the construction activities by conducting geotechnical investigations and initiating design of the outfall tunnel prior to the final review of the EIR/EID reports from the facilities plan.

The stringent timetable associated with the outfall will also require that the following activities be accomplished as scheduled below in order to construct a nine-mile tunnel with an 80-diffuser riser system by July 1995.

November 1987	- Prepare geotechnical documents for bidding.
February 1988	- Bid and award geotechnical contract.
March 1988	- Start geotechnical exploration along tunnel alignment.
May 1988	- Submit preliminary geotechnical exploration information to Design Engineer.
July 1989	- Complete outfall tunnel design.
June 1990	- Award outfall tunnel construction contract.
August 1990	- Start constructing outfall tunnel.
July 1995	- Outfall tunnel complete.

It should be noted that this schedule allows thirty-three (33) months from the preparation of the geotechnical bid documents to the bid and award of construction in June 1990. During this timeframe, all the necessary agency reviews and permitting requirements must be accomplished. In addition, a design engineer must be selected and the tunnel designed.

5.2 CONSTRUCTION PACKAGES

Prior to final design of the recommended facilities, the P/CM will develop the final construction packages to aid the construction bidding process. The following is an initial listing of the major Construction Packages (CP) that may be developed:

- CP 1 - Site Preparation I, Early Site Preparation and completion of Site Preparation I
- CP 2 - Power and Electrical Facilities
- CP 3 - Nut Island Headworks, Inter-Island Wastewater Conveyance Tunnel and South Flow Pump Station
- CP 4 - Effluent Outfall
- CP 5 - Primary Treatment Facilities, Zone A (Phases 1, 2 and 3) and Zone B (Phase 4)
- CP 6 - Residuals Phase 1
- CP 7 - Site Preparation II
- CP 8 - Secondary Treatment Facilities, Zone A and Zone B
- CP 9 - Residuals Phase 2
- CP 10- Site Preparation III

It should be noted that these construction packages are not necessarily construction contracts. One construction package may result in one or more construction contracts.

The preliminary construction schedule and sequencing of construction activities to be undertaken in each construction package are discussed below.

5.2.1 CP 1 - SITE PREPARATION I, 1988-1991

Early Site Preparation 1988-1990

The early site preparation phase of the secondary treatment facilities, Figure 5.2.1-1, consists of those construction activities which can be initiated at an early date to prepare Deer Island for the early 1991 start of construction of the new primary treatment facilities. The major activities in the early site preparation phase of the project include: protection of the existing plant outfall pipes followed by the on-site relocation during the cooler months of 1988 and 1989 of 85,000 yd^3 of existing grit and screenings to a secured landfill, and the excavation, hauling and placing of approximately 1,600,000 yd^3 of central drumlin soils to various on-site locations to create visual and noise barrier landforms. Demolition and removal of the existing water reservoir atop the central drumlin and of the Fort Dawes structures will also be accomplished. The areas disturbed by these early activities will be filled in and graded to meet the required elevations for the construction activities associated with CP6, Residuals Phase 1.

A service water system that will back up the existing plant water system will also be provided. Existing island land access facilities, i.e. roadways, parking lot, security station and fencing, will be relocated as required. A construction haul road will be constructed from the south area of the central drumlin, running parallel to the east and north shore lines, and entering the north area of the island beyond the north prison security fence at the existing prison recreation area. The inability to dispose of excavated drumlin soils off-site until after late 1989 when the on-island piers will be operational can best be circumvented by constructing permanent landforms on existing prison property. If the prison is still operational during the early site preparation period, the existing prison recreation area may have to be relocated to permit the construction of a portion of the northern landform. The full scope of early site preparation is described in Volume VI of the Deer Island Secondary Treatment Facilities Plan.

Completion of Site Preparation I, 1990-1991

After completion of early site preparation in late 1990, the remainder of the central drumlin will be excavated to provide a level platform for the new primary facilities. Through 1991, the excavated materials will be used to construct additional landforms. Should the prison facilities still not be decommissioned by 1989, large temporary stockpiles will be constructed in non-berm areas. Subsequently, the excavated materials will have to be moved more than once prior to final locations being made available for deposition.

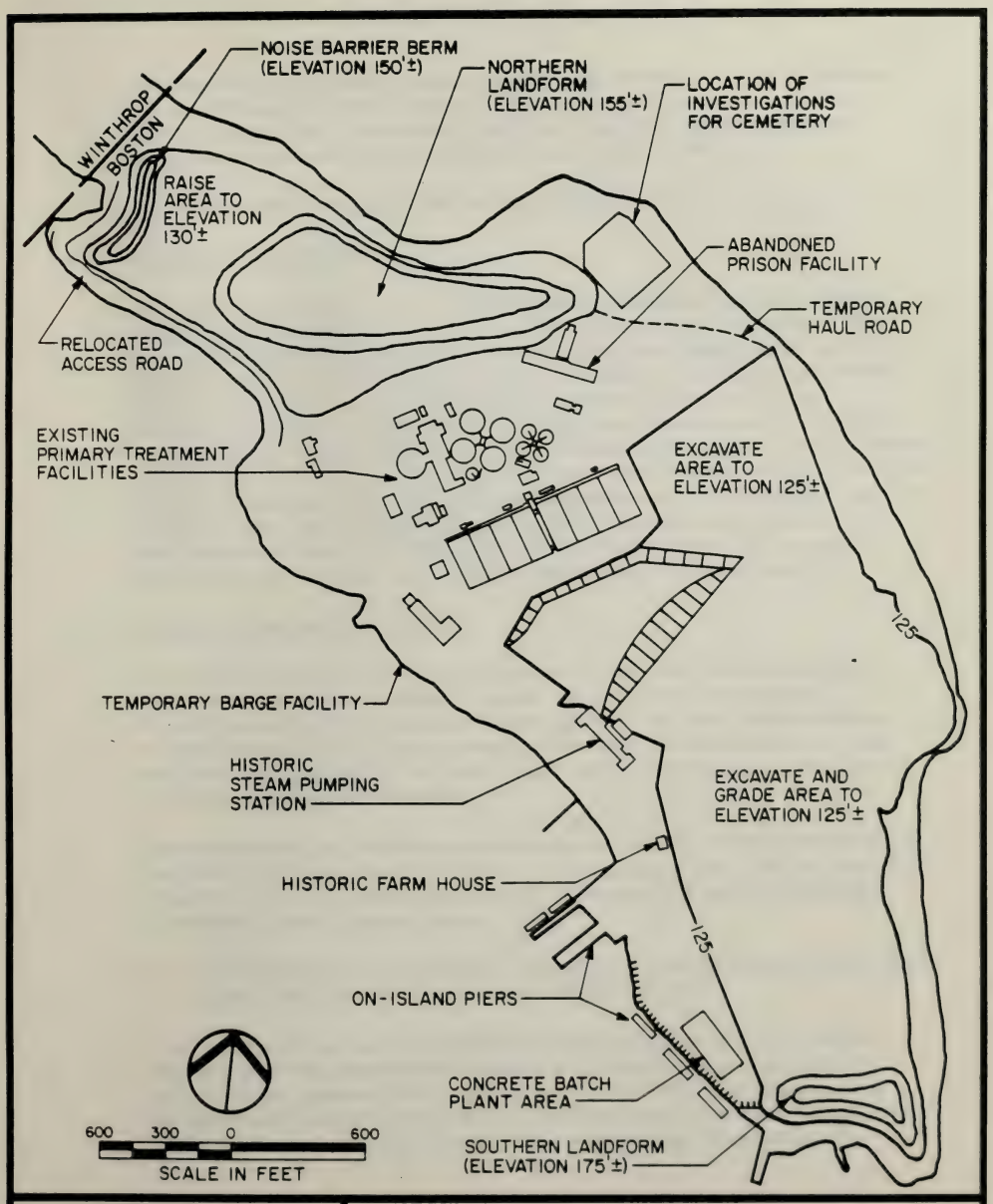

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FIGURE 5.2.1-1

EARLY SITE PREPARATION FOR DEER ISLAND - 1988-1990

The construction of the concrete production plant described in Section 5.4.4 will be undertaken during 1990 to permit the start of construction of the new primary treatment and residuals facilities in January 1991. Construction of the mining shafts for the inter-island wastewater conveyance tunnel and effluent outfall conduit will also be started in 1990.

5.2.2 CP 2 - POWER AND ELECTRICAL FACILITIES, 1988-1995

Immediate Power, 1988-1990

With the start of tunnel construction in 1990, the construction-related power requirements will exceed the current onsite generation capability. Even with the Fast-Track Improvements Program which calls for the installation of two new 6000-kw, dual-fuel diesel engine/generator sets and the rehabilitation of the five existing 700-kw diesels, the immediate construction power demand required by the tunnel boring machines results in a shortfall of 15,550 kw in 1990 as identified in Section 11.1.3 of Volume III. Negotiations are underway to meet this immediate power need via a new 24-kvA Massachusetts Electric Company (MECo) line from MECo's Metcalf substation through Winthrop to Deer Island since Boston Edison Company (BECo) may not be able to provide this construction power via the recommended permanent 115-kv under-harbor line until mid-1991 or later. This immediate installation will also require a temporary 13.8-kv line to a new substation on-island, and the necessary on-island distribution system. The installation will deliver power to the Deer Island construction site by January 1, 1990 or sooner.

Long-Term/Permanent Power, 1988-1995

As identified in Section 11.1.3 of Volume III, a major portion of the electric power required at Deer Island falls into the critical-service category and is, therefore, uninterruptible. BECo will respond to this requirement by bringing separate 115-kv cables capable of delivering 70 MW of power from their K Street substation to Deer Island via submarine cable, and from their Chelsea #488 substation to Deer Island through East Boston across Logan Airport via a combination buried and submarine cable.

Additional power may be provided by a combined-cycle plant to be constructed by the MWRA on Deer Island in two phases, the first of which could begin as early as 1991 if BECo is unable to provide the first 115-kv permanent feeder by 1992. The plant will be capable of generating approximately 26 MW of power by January 1, 1995.

5.2.3 CP 3 - NUT ISLAND HEADWORKS, INTER-ISLAND WASTEWATER CONVEYANCE TUNNEL, AND SOUTH FLOW PUMP STATION 1990-1994

In order to meet the court-ordered implementation schedule, it will be necessary to start the inter-island wastewater conveyance tunnel shaft in 1990, completing the inter-island tunnel work no later than December 1994 in order to allow the new outfall to begin accepting flows from the existing Nut Island Treatment Plant. Construction on the South System Pumping Station on Deer Island and the Nut Island Headworks must be completed no later than July 1994.

5.2.4 CP 4 - EFFLUENT OUTFALL, 1990-1995

To discharge primary effluent from the new primary treatment facilities by 1995, construction of the new plant outfall must begin in 1990 with the sinking of the tunnel shaft at Deer Island. Should it be determined during construction that the accelerated outfall tunnel work will not meet the new primary treatment discharge date of July 1995, a contingency plan will be developed to construct a temporary conduit from the selector zone (temporary disinfection) to the existing outfall conduit. This temporary conduit work will be done as part of CP 6.

Alternate construction methods and schedules for the plant outfall will continue to be studied by the P/CM during final design to minimize construction impacts and accelerate progress. For example, the installation of precast panel tunnel liners could save up to one year in construction time.

5.2.5 CP 5 - PRIMARY TREATMENT FACILITIES, ZONE A (PHASES 1 AND 2) AND ZONE B (PHASE 3), 1991-1995

The new primary treatment facilities, Figure 5.2.5-1 and 5.2.5-2, will be constructed in three phases to accelerate the construction schedule. The phases are described below:

Zone A, Phase 1 - 1991-1993

- Main Pump Station and Winthrop Terminal modifications
- North System Force Main

Zone A, Phase 2 - 1991-1993

- Grit facilities
- Control building
- Odor facility
- Administration building - existing pump station modification and addition

Zone A, Phase 3 - 1992 - 1994

- Primary Clarifiers batteries A and B
- Temporary disinfection facilities, Selector Zone A
- Temporary primary conduit connecting Selector Zone A to the existing outfall
- Primary splitter box
- Secondary splitter box
- Primary screening facilities
- Primary sludge and scum pumping galleries

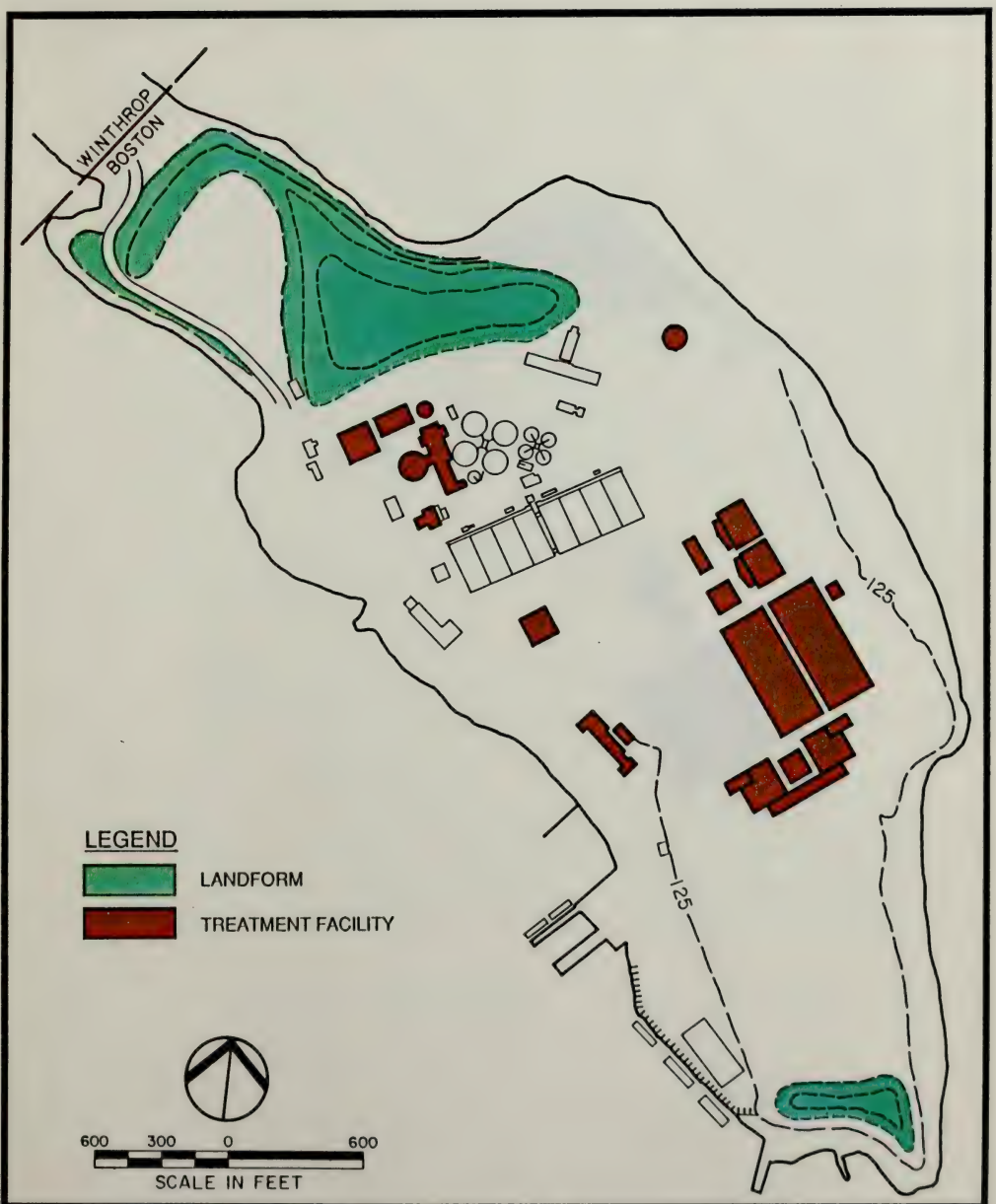

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FIGURE 5.2.5-1

PRIMARY TREATMENT FACILITIES
ZONE A COMPLETE - 1991-1993

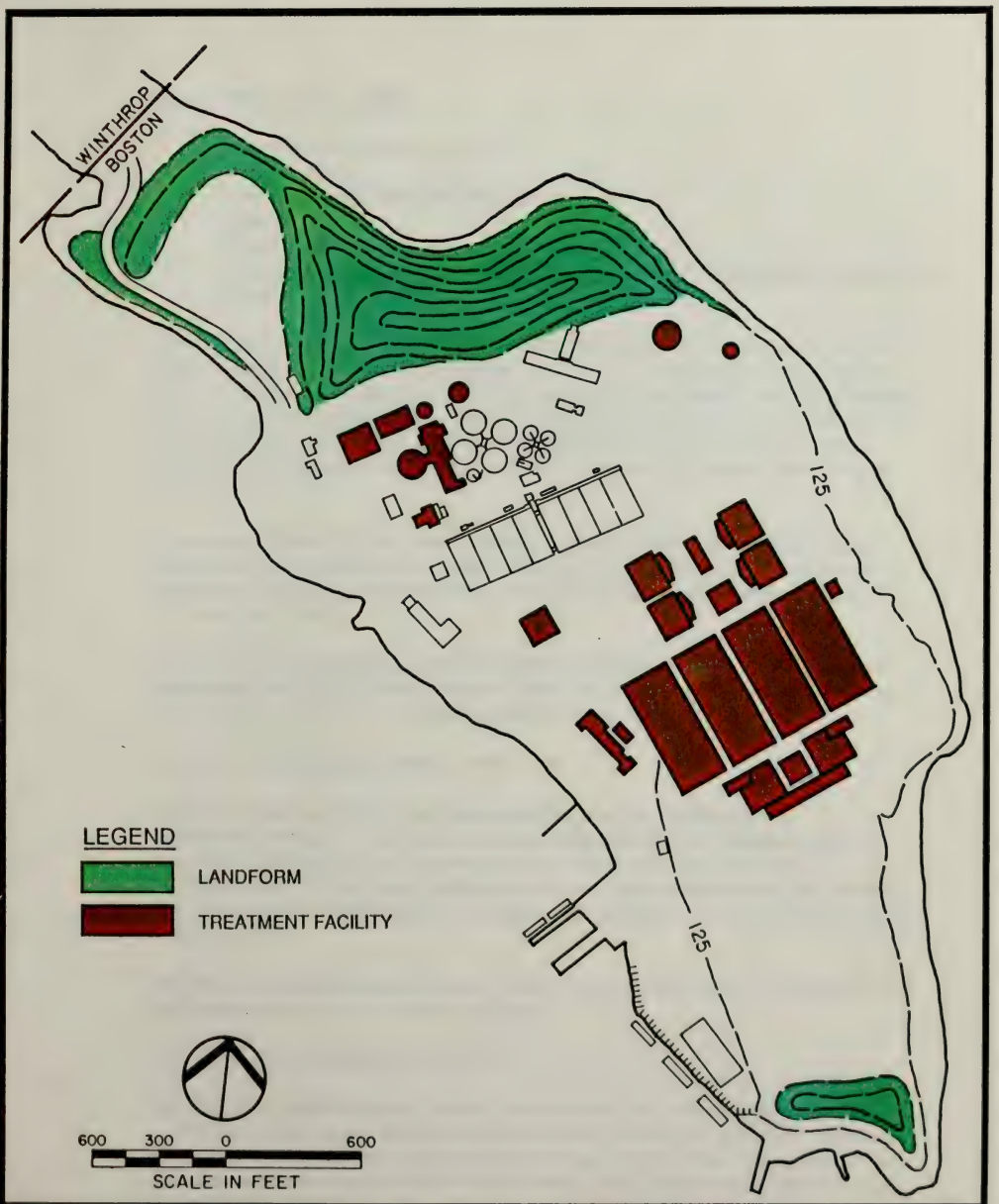

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FIGURE 5.2.5-2
PRIMARY TREATMENT FACILITIES
ZONE A AND ZONE B COMPLETE -
1991-1995

Zone B, Phase 4 - 1992 - 1995

- Primary clarifiers batteries C and D
- Selector Zone B
- Temporary conduit from Selector Zone B to existing outfall
- Primary sludge and scum pumping galleries
- Maintenance building may be constructed earlier to provide for equipment and spare parts storage.

Construction of primary treatment Zone A, as shown on Figure 5.2.5-1, will begin with Phase 1 starting in January 1991 following completion of CP 1 early site preparation work. Zone A Phase 2 will begin six months after Phase 1 has started, and both Phases 1 and 2 are scheduled to be completed by December 1993. Zone A Phase 3 will begin in January 1992 and should be completed by mid 1994. Should no delays be encountered as a result of the pile driving operations and foundation work, Zone A facilities will start receiving primary flow by the end of 1994.

Construction of Phase 4 of the primary treatment facilities in primary Zone B will start in January 1992. Phase 4 should be completed by July 1995 if no problems are encountered with the pile driving operations and foundation work. Zone B is scheduled to be tested in the fall of 1995 and winter 1996.

Full flow primary treatment is scheduled to begin in December 1995. Final operational tests and acceptance of the new primary treatment facility are scheduled to meet the court-imposed date of January 1996, with construction completed by July 1995.

5.2.6 CP 6 - RESIDUALS PHASE 1, 1991 - 1995

At this time, planning efforts for the residual facilities have not yet identified the recommended facilities. An area has, however, been assigned for the residual facilities, and it is assumed that these facilities will be constructed concurrently with CP 5 work. Appropriate sections of the sludge handling facilities will be completed by mid-1994 and tested by the end of 1994 to meet the sludge processing needs of Phases 1, 2 and 3 of the new primary treatment facilities.

The remaining sections of Residuals Phase 1 should be completed in time to meet the July 1995 court-imposed date for primary treatment facilities.

5.2.7 CP 7 - SITE PREPARATION II, 1992 - 1995

This work will continue the earth excavation and landform construction efforts started under CP 1. The visual buffer screens will be extended north and east along the shorelines. Some areas needed for the construction of secondary treatment Zone A will be cleared and graded. Prison demolition and removal, with the area filled to existing grade, will also be completed during

this period. Handling of the outfall and inter-island tunnel spoils on-island will be included.

5.2.8 CP 8 - SECONDARY TREATMENT FACILITIES, ZONE A AND ZONE B, 1995 - 1999

The secondary treatment facilities, Figures 5.2.8-1 and 5.2.8-2, will be constructed by zones. Construction in Zone A will begin in July 1995. The secondary clarifiers and aeration basins are phase-scheduled to begin a year later. The disinfection basin will be constructed by November 1997. With the entire Zone A treatment facilities construction completed by mid 1998, shake-down and testing of Zone A facilities is scheduled to be completed by December 1998. Zone A facilities should be ready to start secondary treatment operations by early 1999.

Construction of Zone B secondary treatment facilities will start July 1996 and should be completed by mid 1999. Full-flow secondary treatment is expected to begin by the end of 1999. Final operations tests and MWRA acceptance of the new secondary treatment facilities are scheduled for June 2000.

The specific facilities to be constructed in each secondary treatment zone are identified below.

Zone A, 1995 - 1998

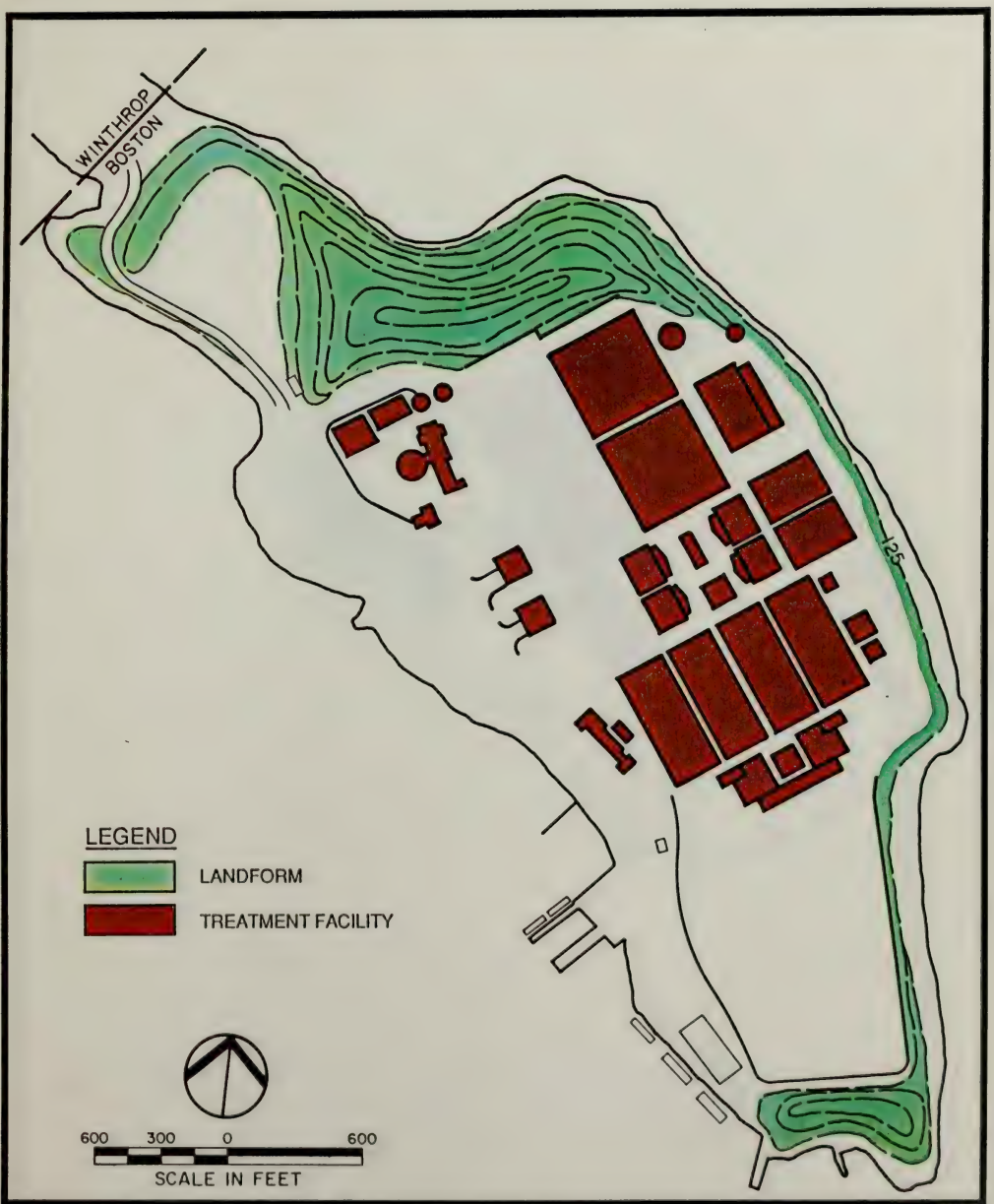
- Secondary clarifiers batteries A and B
- Aeration basins batteries A and B
- Secondary conduits
- Disinfection basin
- Cryogenic generators
- Secondary sludge pumping station

Zone B, 1996 - 1999

- Secondary clarifiers batteries C and D
- Aeration basins batteries C and D
- Secondary conduits
- Secondary sludge pumping system

5.2.9 CP 9 - RESIDUALS PHASE 2, 1995 - 1999

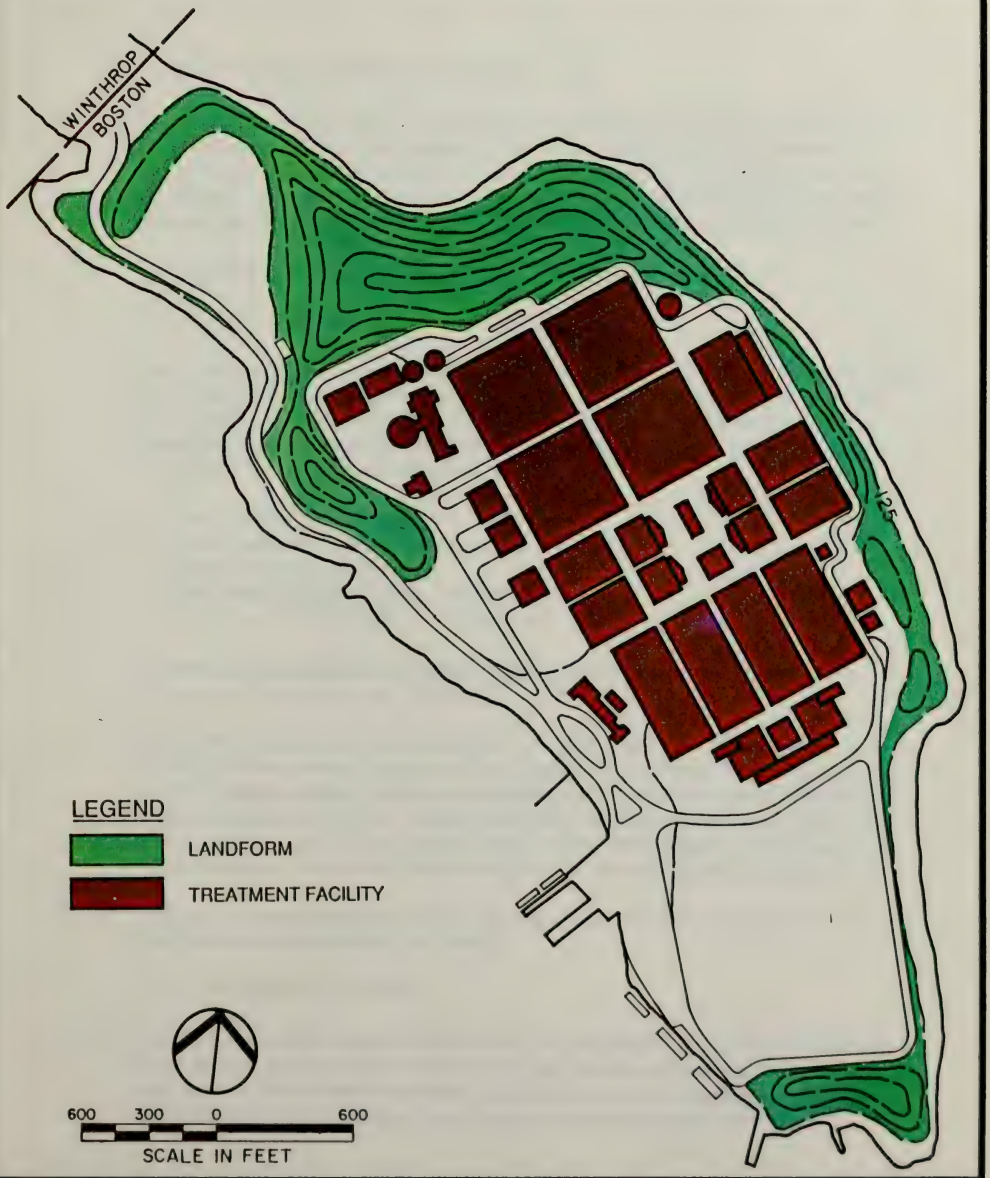
This work will be undertaken concurrently with CP 8 construction activities. Sufficient sections of the sludge handling process will be completed by July 1998 to accept secondary sludge from the secondary treatment Zone A phase. The remainder of the Residuals Phase 2 work will be completed in time to accept the full flow secondary sludge in 2000.



MASSACHUSETTS WATER RESOURCES AUTHORITY

FIGURE 5.2.8-1

SECONDARY TREATMENT FACILITIES
ZONE A COMPLETE - 1995-1998



MASSACHUSETTS WATER RESOURCES AUTHORITY

FIGURE 5.2.8-2
SECONDARY TREATMENT FACILITIES
ZONE A AND ZONE B COMPLETE -
1995-2000

5.2.10 CP 10 - SITE PREPARATION III, 1996 - 1999

The final site preparation work will proceed in conjunction with CP 8 and CP 9 activities. The work will consist mainly of the demolition of the existing primary facilities, completion of the site landforms, completion of grading, construction of permanent roads and paving, and landscaping. Demolition of the existing primaries will occur immediately after the new primary treatment facilities are brought into service by the MWRA operations and maintenance staff.

5.3 CONSTRUCTION QUANTITIES

5.3.1 EXCAVATED MATERIALS

The recommended plan requires the movement and use or removal of between 5.5 and 6.3 million cubic yards of material. The estimated range reflects the variations depending on the length of the outfall. The smaller estimated volume includes excavated material for a five-mile outfall; the larger estimated volume includes material from an outfall extending nine miles. The primary sources of excavated material include:

- Main drumlin - 3,000,000 yd^3
- Existing grit and screenings - 85,000 yd^3
- Demolition debris - 122,000 yd^3
- Inter-Island conveyance tunnel - 200,000 yd^3
- Outfall tunnel - 953,000 yd^3 to 1,700,000 yd^3

In addition to these materials, excavation associated with the development of related water transportation facilities may add 150,000 yd^3.

Of the total volume of material, approximately 4.7 million cubic yards will be used to construct the recommended landforms on Deer Island. The landforms will be constructed as material becomes available from excavation throughout the construction period. The remaining material, ranging from 1.0 to 1.7 million cubic yards, will require re-use at off-island sites such as the Central Artery/Third Harbor Tunnel Project, ocean disposal, or off-island secured disposal, depending on the timing of excavation and the source on quality of the material.

Table 5.3.1-1 lists the anticipated annual rates of excavation for the project. Table 5.3.1-2 identifies the proposed re-use for the material.

5.3.2 CONCRETE QUANTITIES

The recommended plan includes reinforced concrete structures for the process units and steel frame masonary structures for the administration and maintenance buildings. Concrete pile supported foundation studies are presently ongoing for most of the process unit structures. Foundation structures will be established during the preliminary design phase with the assistance of the P/CM.

Table 5.3.2-1, "Concrete Quantities", lists the anticipated annual rates of on-site concrete

TABLE 5.3.1-1

SOURCES AND VOLUME OF EXCAVATED MATERIAL
(Excavated Materials yd^3)

Source	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	TOTALS
Grit and Screening (Rebuild)	30,000	55,000												85,000
Main Dromlin		230,000	1,370,000	1,154,000	246,000									3,000,000
Fort Dawes (Demo)		20,000	23,000											43,000
Grit Facilities			16,000	30,000										46,000
South Flow Pump Station				33,000										33,000
Primary Facilities				44,000	66,000	43,000	20,000							173,000
Selectors and Control Bldg					38,000	40,000	34,000							112,000
Maintenance Buildings				5,400										5,400
Administration Building						2,400								2,400
Nut Island Headworks						23,000	10,000							33,000
Inner Island Tunnel			39,000	32,000	32,000	32,000	65,000							200,000
Plant Outfall (5-9 miles)			60,000	205,000	205,000	205,000	205,000	73,000						953,000
				to	to	to	to	to						to
				369,000	369,000	369,000	369,000	164,000						1,700,000
Prison Facilities (Demo)			41,000											41,000
Secondary Clarifiers								114,500	200,000	200,000	100,000			614,500
Existing Primaries (Demo)									38,000					38,000
Aeration Facilities									55,000	50,000				105,000
Dewatering Facilities									22,000	30,000				52,000
Total Range	30,000	305,000	1,549,000	1,503,400	587,000	345,000	334,000	187,500	315,000	280,000	100,000			5,536,300
				to	to	to	to	to						to
				1,667,400	751,000	509,400	498,000	278,500						6,283,300

Note 1 Does not include approximately 150,000 yd^3 of dredged material from on island pier construction

TABLE 5.3.1-2

PROPOSED DISPOSAL OPTIONS FOR EXCAVATED MATERIAL

(Excavated Materials Reuse yd^3)

Destination	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	TOTALS
On Island Burial	85,000													85,000
North Landform		250,000	1,195,000	800,000	346,000	219,400	113,600	129,000	115,000	148,000	50,000			3,366,000
East Landform								77,500	122,500	110,000	18,000	32,000		360,000
South Residual Area & Landform			354,000	245,000	195,000	190,000								984,000
Off Island Disposal				622,400	210,000	100,000	384,400	72,000	77,500	22,000				1,488,300
Totals		250,000	1,549,400	1,667,400	751,000	509,400	498,000	278,500	315,000	280,000	68,000	32,000		6,283,300

NOTE 1 Revised quantities assumes the nine (9) mile effluent outfall is constructed. Should a five (5) mile effluent outfall be constructed, 747,000 yd^3 less material will be disposed off island.

NOTE 2 150,000 yd^3 dredged materials from the on-island pier construction also will be disposed of off island.

TABLE 5.3.2-1

Concrete (yd^3)

Structure	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	TOTALS
Nut Island Headworks						9,570	4,930							14,500
Main North Pump Station														--
Grit Facilities				4,200										4,200
Primary Facilities				50,000	75,000	65,000	16,000							206,000
Screening Facilities					1,500									1,500
Aeration Facilities									10,000	36,000	15,000			61,000
Cryogenic Facility										1,300				1,300
Secondary Clarifiers								35,000	103,000	85,000	48,000			271,000
Disinfection Facilities									13,000	12,000				25,000
Administration Building						1,200								1,200
Maintenance Building				2,500	2,500	2,500								7,500
South System Pump Station				8,000	13,000									21,000
Inter-Island Tunnel				7,000	10,000	10,000	10,000	3,000						40,000
Plant Outfall (5-9) miles				26,000	40,000	40,000	40,000	19,000						165,000
				to	to	to	to	to						to
				47,000	73,000	73,000	73,000	34,000						300,000
Total Range				97,700	142,000	119,270	70,930	57,000	126,000	134,300	63,000			819,200
				to	to	to	to	to						to
				118,700	175,000	152,270	100,393	72,000						954,000

usage for the reinforced concrete structures and tunnels. The total demand ranges from 0.8 to 0.95 million yd^3, depending on the length of the outfall. The peak demand years are 1992 to 1993, with concrete needs extending from 1991 to 1998. The list does not include concrete for piles.

5.3.3 PERSONNEL

During early site preparation when the on-island piers are not yet available and the work force is small, workers will drive to the site. Carpooling and use of public transportation will be encouraged. As the work force expands following the availability of the on-island piers in 1989, the workers will travel mostly by automobile either to satellite parking areas from which they will be bused to Deer Island, or to on-shore piers where they will travel by ferry boats to Deer Island. At least one-half of the construction workers will be transported on water from ferry facilities to Deer and Nut Island; the other half may be bused to Deer Island through Winthrop, from satellite parking facilities on the mainland.

The estimated average daily construction worker requirements range from 245 to 1598. Peak worker needs occur in 1992 and 1993 during construction of the primary treatment facilities, and also in 1995 - 1997 during construction of the secondary treatment and aeration facilities. The peak personnel needs in 1992 and 1993 reach almost 1,800 per day and average about 1598 daily workers. In 1995-97 the peak requirement reaches 915 per day and averages approximately 900 daily workers.

Personnel requirements for the period 1991-1999 are shown in Table 5.3.3-1.

5.4 CONSTRUCTION SUPPORT

The potential use of a program/construction management approach to support the implementation of the major construction package is analyzed in detail in Section 6.

The P/CM approach allows for the integration of construction-related knowledge into the design and implementation planning process while enhancing the probability of the project's completion on time and within budget. The P/CM will be responsible to the recommended MWRA Program Management Unit for the management and coordination of design, cost estimating, scheduling, permitting, (see Section 6 for the proposed organizational structure) value engineering, equipment pre-purchasing, resident engineering, facility testing, and staff training. The P/CM will also provide the MWRA technical support regarding contractor selection, change order control, progress payments and final acceptance.

The following sections, 5.4.1 to 5.4.10, provide background information, organizational options and, in some cases, preliminary recommendations on key issues requiring the immediate attention of the P/CM. Final recommendation requires analysis by the P/CM. The issues include:

- o Pre-purchase of Equipment
- o Overland Transportation
- o Overwater Transportation

TABLE 5.3.3-1

ESTIMATED DAILY CONSTRUCTION WORKER VOLUME, BY YEAR (1991-1999)

	WORKERS	
Year	Average	Peak
1988	424	486
1989	424	486
1990	155	160
1991	906	990
1992	1653	1856
1993	1653	1856
1994	1123	1240
1995	840	985
1996	670	875
1997	670	875
1998	320	415
1999	245	320

- o Concrete Production
- o Materials Handling and Storage
- o Laydown Areas
- o Office Space Requirements
- o Construction Power Requirements
- o Site Security
- o Construction Innovations Analysis

5.4.1 PRE-PURCHASE OF EQUIPMENT

The completion of construction on an optimum schedule may require extensive pre-purchase of critical equipment components. To assure completion, the P/CM wil establish a pre-purchase of equipment program for MWRA during the design phase of the project.

By implementing this program at the initial design stage, the potential for the following is increased:

- o Economy of quantity and, thus, potential cost reductions.
- o Availability of equipment when needed for installation.
- o Provision of similar equipment throughout the plant, enhancing maintenance and reducing the quantity of spare parts.
- o Deletion of major equipment costs (pre-purchased) from construction contracts, thereby reducing contract size and attracting additional competition due to lower bonding requirements.
- o Reduction in vendor drawing review and approval
- o Availability of equipment details necessary for design

Equipment to be pre-purchased will be selected by the P/CM on the basis of the equipment speciality, long fabrication and delivery schedule times, and impact on the project schedule. For example, there are four batteries of 24 stacked clarifiers in the primary treatment system. These clarifiers will include 192 sludge/scum collectors. The first battery of basins will be ready for installation of the sludge/scum collectors in 1992. The need to pre-purchase this large number of sludge/scum collectors is be typical of the pre-purchase program to be investigated by the P/CM.

The secondary treatment facilities will include a stacked secondary clarifier system consisting of four batteries of 36 clarifiers each. These clarifiers will require 288 sludge collectors. In addition, the secondary system will include an oxygen aeration system with 28 surface aerators. Oxygen for the aeration system will be produced and distributed to the enclosed surface aerators by two cryogenic generators. To avoid any delivery delays for this equipment, the P/CM should investigate the need to pre-purchase the sludge collectors, aerators, and

cryogenic generators.

Ten new pumps are required as part of the modifications to the Main Pumping Station (MPS). The capacity of each pump is estimated to be 90 million gallons per day (mgd). However, consideration should be given to increasing the design capacity within the limits imposed by acceptable velocities on the suction side of the pumps and the capabilities of manufacturers to fabricate and guarantee the performance of these custom pumps. If pumps larger than 90 mgd are ultimately selected, they should be pre-purchased. It should be noted that the selected pump affects the specification and design of the other major components involved in the MPS modification (motors, variable speed drives, drive shafts, piping, valves, and switchgears).

The pre-purchase program must also include the development of appropriate vendor bid documents and contracts for the equipment, scheduling of shop drawing submissions and reviews, monitoring of fabrication and delivery equipment schedules, coordination of equipment deliveries with construction contract work, monitoring of equipment storage and installation, and approval of partial payments.

Pre-purchased equipment must be warehoused at the designated staging area and transported to Deer Island on an as-needed basis. Methods to be used in the acceptance, inspection, and maintenance of the equipment during storage will be developed by the P/CM. If required, extended warranties and interior storage requirements will be identified and incorporated into the purchase agreements by the P/CM.

Based on the final installation schedules established by the P/CM, the vendors will be requested to make deliveries to the predetermined storage areas on a pre-established schedule. This will assure availability of equipment, minimize warehousing needs at the storage facility, and reduce the cash flow.

5.4.2 OVERLAND TRANSPORTATION

Personnel

It is planned that a maximum 50 percent of the peak workforce will be bused to the island. To ensure that the mitigation commitment limiting the number of construction worker vehicles traveling through Winthrop to Deer Island is met, it is recommended that the MWRA and the P/CM investigate the feasibility of contracting with a local bus service or the MBTA to transport workers from designated satellite parking areas to Deer Island. To ensure coordination among contractors, each contractor could be required to provide time schedules outlining the specific work crews to be transported to the island.

Construction workers to Nut Island will provide their own transportation.

Materials and Equipment

Prior to the completion of the on-island piers, deliveries of the construction materials and equipment to the Island through Winthrop will be scheduled by the contractor and approved by

the CM to ensure compliance with the MWRA mitigation commitments. Following completion of the piers, the vast majority of the construction materials and heavy construction equipment will be delivered to Deer Island overwater.

5.4.3 OVERWATER TRANSPORTATION

Personnel

It is planned that, upon completion of the on-island pier facilities in 1989, at least 50 percent of the estimated peak workforce at Deer Island will be transported over water to the on-island job-site via ferries from on-shore satellite parking facilities. To control the number of vessels docking at the on-shore and on-island piers, MWRA must consider contracting with a water transportation company to provide ferry service for construction workers to Deer Island. For this service option the individual contractors will identify the schedules needed for the specific work crews and based on these schedules, the P/CM will develop ferry service schedules. Other transportation options, such having MWRA directly provide the vessel and transportation system, could also be examined by the P/CM.

Materials and Equipment

Transportation of the vast majority of construction materials and equipment, as well as operations supplies, to Deer Island will be made either by roll-on/roll-off (RO/RO) vehicles transported by boats and/or barges traveling between the on-shore and on-island piers. Deliveries of the contractors' construction materials and equipment to the island should be scheduled by each contractor and approved by the P/CM. Partial payments should be approved by the P/CM only for materials and equipment delivered to the island or to an approved staging area.

It is anticipated that bulk materials will be shipped directly to Deer Island from their sources of supply as scheduled by the contractor and approved by the P/CM. Excess excavation materials, if any, will be bulk barged off-island, either to a harbor island or ocean disposal site, or to on-shore piers where the materials will be trucked to an approved landfill or sold as needed.

5.4.4 CONCRETE PRODUCTION

Under normal construction conditions, the following three options are normally available for the supply of concrete:

Option 1 - Conventional, commercial ready-mix truck delivery;

Option 2 - Individual contractor operated plants; and

Option 3 - Owner-Operated, control-mix plant (multi-contractor site).

Option 1 is not feasible due to the transportation mitigation measures which restrict the

volume of truck traffic through Winthrop and the time delays in moving trucks over water. This will increase the time and distance from the on-shore concrete production plan to the remote island site.

Option 2 is not feasible due to space limitations on Deer Island and the number of contractors needed to complete the project.

Option 3, an owner-operated, on-site control-mix plant, will ensure that the quality and quantitites of concrete required for the project will be supplied in accordance with schedule requirements. Option 3 would eliminate the time, distance and area difficulties associated with Options 1 and 2. A concrete production plant on Deer Island would be capable of producing and maintaining all concrete requirements during the entire construction period, 1990-1999.

There are two conceptual ways to approach Option 3. The first is to specify a plant to meet performance criteria, i.e. only establish a maximum yd^3/hr production rate. The second way is to specify the types of equipment needed to meet the established maximum yd^3/hr production rate. The second concept is more advantageous to the MWRA for, by specifying the plant equipment, the risk associated with the operation would be minimized. A final recommendation should be made by MWRA upon further study by the P/CM.

Typical components of the plant which should be specified are listed below. The quantities noted are preliminary estimates derived to project the requirements for laydown areas. Final quantities should be confirmed by the P/CM. The components include:

- Barge unloading area/equipment for bulk cement and aggregates.
- Separate stockpiles for fine and coarse aggregates for a minimum of 10,000 yd^3 of concrete.
- Bulk cement storage for 12,000 barrels.
- Reclaim tunnel from stockpile to concrete plant.
- 250 yd^3/hr enclosed concrete mixing plant, computer controlled.
- Heating plant to control concrete temperatures during the winter months.
- Cooling plant to control concrete temperatures during the hot months.
- Waste/wash-water retention pond.
- Concrete testing facility for inspecting, testing and storing plastic and hardened concrete samples.

The P/CM will recommend to MWRA the final arrangement and layout of the concrete production plant on Deer Island based upon final quantities to be developed by the P/CM and the design

engineers. Should a P/CM not be retained by MWRA prior to the design and execution of the concrete production plant, MWRA will need to prepare the appropriate arrangement and layout documents for the concrete production plant.

The operator of the Concrete Production Plant will be under contract to the MWRA for specific periods of time during the construction of the treatment facilities. The operator's contract will be subject to rebid/renegotiation at specific intervals to be determined by the P/CM.

The operator will stockpile sufficient quantities of concrete materials on-island to maintain the production schedules predetermined by the P/CM to meet project schedule. The operator will schedule through the P/CM barge deliveries of concrete materials as needed to maintain the required stockpiles.

An independent concrete testing laboratory, located in close proximity to the plant, will provide plant inspection and complete testing for the project. To assure that all concrete meets the specified quality standards, the concrete testing service will be performed by a firm specializing in this type of work and under contract with the MWRA.

If a contractor has the option of furnishing precast concrete items, the contractor would use an on-shore concrete batch plant designed to meet the concrete quality standards. Appropriate testing facilities would also be provided.

The P/CM will oversee, coordinate, and monitor all concrete production and testing activities.

Concrete for the construction of Nut Island facilities will be supplied by the individual contractors through conventional, commercial ready-mix truck delivery.

5.4.5 MATERIALS HANDLING AND STORAGE

To implement the pre-purchased equipment concept described in Section 5.4.1, provisions must be made for warehousing and storage. It is recommended that any staging facility selected should have provisions for long-term storage and warehousing. The materials and/or pre-purchased equipment will be stored at this facility until required for installation by the contractor.

A recommended option for providing materials handling capability is the delegation of this function to a contractor directly responsible to the P/CM. The contractor's responsibility will include:

- Erection and/or maintenance of a suitable storage facility at the designated staging area.
- Receipt and inspection of pre-purchased equipment/materials and provision to the P/CM of the required quality control documentation.
- Routine vendor-recommended preventive maintenance while at the storage facility, to meet warranty requirements.

- o Inventory control and documentation.
- o Issue of requisitioned equipment/material for island transport as requested by contractors.
- o Receipt/cataloging of operation and maintenance manuals.
- o Provision of adequate security for the storage facility.

5.4.6 LAYDOWN AREAS

On-Island

Due to site limitation and the number of contractors, large on-site areas for the long term storage of material/equipment will be unavailable. To overcome this problem, laydown areas must be provided by the owner on the individual contract. Provision of some space by the owner on-site will expedite the construction program. In this option, the P/CM will designate in the contract documents limited areas for each contractor's use adjacent to his work area. The actual location, size and duration available will be specified. These designated areas will be allocated to the individual contractors primarily for the short-term storage of material/equipment. This arrangement will mandate that contractors schedule their shipments to Deer Island through the P/CM on an as needed basis to avoid construction delays.

On-Shore

An off-island laydown area covering 30 to 40 acres located adjacent to the off-island barge facility will be required. The actual acreage, including warehouse requirements, will be determined by the P/CM based on the quantities and deliveries of pre-purchased equipment, and the staging of contractor-supplied materials. The P/CM will determine the extent of the off-island laydown required as these developments take place.

Should precast concrete liners be selected for the plant outfall, an additional 20 to 30 acres will be required for the fabrication and storage of the liners.

5.4.7 OFFICE SPACE REQUIREMENTS

Several peak project construction periods will occur in the 1991-1999 period. At times, there will be from twelve to sixteen general contractors, plus their subcontractors, working on Deer Island. To assure that this number of contractors will have sufficient temporary office space available on-island, and because on-island space is at a premium, the P/CM should investigate locating a barge facility or a temporary on-island office complex. The on-island office complex may consist of an arrangement of trailers to form a temporary high-rise structure. Space will be allocated to the contractors on a priority basis.

In order to minimize the need for constructing temporary structures for office space, it is anticipated that the Deer Island Steam Pumping Station will be modified for this use. The

renovation of this existing structure, and the construction of the proposed additions, will support the temporary office space needs of the P/CM and the on-site MWRA contingent.

The exterior shell of the Pumping Station addition and the modification of the existing building exterior will have to be built early. Temporary partitions and enclosures will have to be built for the duration of construction. As the level of construction declines, the permanent finish of the interior will be installed and the areas made available to permanent site staff.

This concept of utilizing permanent structures for temporary facilities will also be advantageous in saving valuable on-island space and in reducing construction costs of temporary facilities. It is, therefore, important for MWRA and the P/CM to identify and authorize the earliest procurement of architectural and design service contracts for such structures, so they may be constructed early.

The P/CM should investigate the use of the Maintenance Warehouse foundation slab on which to construct a Butler Building-type structure to house additional temporary offices. The maintenance warehouse is scheduled to be constructed during early 1991, and the slab section could be used if there is no immediate need for this space.

The P/CM should also investigate using existing buidings at the on-shore pier locations as temporary office space.

5.4.8 CONSTRUCTION POWER REQUIREMENTS

Normal construction practice is to use local permanent power, where available, for temporary construction needs. In cases where local power is unavailable, or a remote site location is encountered, temporary construction power is provided by mobile generators.

At the Deer Island location, sufficient permanent power is currently unavailable and a shortfall of 550 kw is projected by 1988. Furthermore, even the rehabilitation of the existing generator sets and the installation of new diesel generator sets under the Fast-Track Improvement Program will not be sufficient to meet the power needs of the existing treatment plant plus the power needs for the tunnel boring machines, concrete production plant, and other basic construction power needs for the erection of the treatment facilities. By 1990, a shortfall of 15,550 kw is projected.

Greater use of the engine generators at Deer Island is environmentally inappropriate due to the air quality and noise considerations. It is also much more expensive than using permanent transmission lines. Therefore, it is imperative that MWRA or the P/CM take the appropriate steps in procuring the proper power supplies. It is recommended in Volume III of the Secondary Treatment Facilities Plan that the immediate power needs be met in 1990 by connecting to the Winthrop facilities of Massachusetts Electric Company via Boston Edison Company facilities.

The need to provide for construction power is urgent in order not to impact the already aggressive construction schedule. The MWRA must immediately file the appropriate service

requests and fees to allow negotiations and design to proceed. The MWRA will be responsible for providing its own on-island substation and distribution system.

5.4.9 SITE SECURITY

To provide adequate site security during construction at Deer Island, Nut Island, and the designated staging area, the P/CM or MWRA must engage a security force for the entire construction period. The security contractor's responsibilities might include items such as 24-hour, seven-days-per-week site surveillance, personnel entrance and exit checks at designated locations, and vehicle access control onto and off sites. The security force contractor will also serve the dual function, when the contractors are not on site, of detecting and reporting fires and/or unusual occurences at the site.

Other security measures could include requiring that all workers on the islands be required to wear photo-identification badges displaying their name, company name and job employment numbers. As well, workers on-site might be required to wear designated color hardhats identifying their company. The security contractor also could be required to check employees in and out at all access points by land or sea.

The construction site security contract should remain in effect until the permanent plant security facilities and personnel are available and operational.

5.4.10 INNOVATIVE CONSTRUCTION TECHNIQUES

An on-going construction innovations program to minimize construction costs and maintain schedule commitments must be encouraged by the P/CM. This innovations program should be implemented early during the design phase, and concurrently with the constructability reviews, for maximum effectiveness. The selected contractors will also be expected to recommend and use state-of-the-art construction methods and techniques to overcome project constraints and construct the new facilities to the full intent of the contract documents within the specified time and budget. Elements which should be given further detailed consideration in the program are:

- 3-dimensional Computer Models - develop and use 3-dimensional, dynamic computer models in place of conventional physical models to aid project design and estimating, determine construction interferences, aid scheduling and status reporting, provide early operations and maintenance training, and increase public understanding of the plant construction and operation activities.

- Precast Concrete - use precast concrete pipes and tunnel sections, roof panels, and basin walls to minimize on-island concrete production and personnel transport.

- Modular Reinforcing Bar Assemblies - prefabricate reinforcing bar sections to reduce erection time on-island.

- Modular Concrete Forms - develop concrete structure design to accommodate the use of a

modular concrete forming system to facilitate concrete construction.

- Skid-Mounted Components - shop-fabricate and pretest skid-mounted system modules to reduce field erection time.

- Construction Area Lighting - provide lighting to facilitate area security and second shift construction activities.

- Concrete Additives - in addition to air entraining and water reducing agents, investigate the use of additional concrete additives such as "super placitizers" to increase workability without increasing the water to cement ratio.

5.5 PERMITTING PLAN

5.5.1 BACKGROUND

The purpose of the Permitting Plan is to identify the necessary permits and establish a permit approval schedule for each of the project components. Tentative recommended project alternatives have been identified for the Early Site Preparation, Utility Supply, Inter-Island Conveyance System, Treatment Plant, and Outfall Facilities. These recommended alternatives are addressed in this permitting assessment. For the purposes of this evaluation, the five project components and their associated final EID/EIR submittal dates are summarized chronologically below. For two of these components, Inter-Island Conveyance System and Outfall Facilities, the Environmental Protection Agency (EPA) will be preparing a joint Supplemental Environmental Impact Statement (SEIS).

1. Early Site Preparation - Involves the movement of Deer Island soils preparatory to construction of primary treatment facilities; demolition and removal of certain structures (e.g., concrete bunkers at Fort Dawes); removal and final closure and disposal of grit and screenings; removal and replacement of water holding tank from the drumlin, and protection of the existing outfall on Deer Island. The draft and final EID/EIR submittal dates for Early Site Preparation are September and November 1987, respectively.

2. Provision of Off-Island Utilities Supply - To support construction and interim facilities on Deer Island. Utility routes for electricity, water, gas, and telecommunications will require excavation activities overland and/or across the harbor. The recommended approach for developing the required power supply to support construction and operations at the Deer Island facility is to make provisions for immediate power from Massachusetts Electric through Winthrop by January 1, 1990; install the first 115 kv permanent feeder from K Street by January 1, 1991; install the simple cycle combustion turbine by January 1992 and the remainder of the combined cycle power plant by January 1993; and install the second 115 kv permanent feeder from Chelsea by January 1, 1995. Included in Volume III are provisions for construction, design, and environmental impact evaluation for immediate power and on-site power. Not included in the document are the design, impact assessment, and

permitting for the two 115 kv sources from K Street and Chelsea. These will be provided by BECo.

3. Inter-Island Conveyance System - Involves the construction of a tunnel between Nut Island and Deer Island to convey wastewater from the South System to Deer Island; and the construction of a pump station on Deer Island to receive South System flows and pump them to treatment facilities on Deer Island. The draft and final EID/EIR submittal dates for the Inter-Island Conveyance System are September and December 1987, respectively. The EPA Record of Decision (ROD) on the joint Inter-Island Conveyance System/Outfall Facility SEIS is presently scheduled for May 31, 1988.

4. Treatment Plant - Involves the development of a Deer Island site plan, selection of treatment plant design, and the construction of the wastewater treatment plant, support facilities, and provision of utilities to support the treatment works. Also included in this project component is the development of a Nut Island site plan which will provide for removal of the existing wastewater treatment facilities, and construction of a new headworks facility which will provide preliminary treatment for South System wastewater prior to conveyance to Deer Island. Draft and final EID/EIR submittal dates for the Treatment Plant are October 1987 and March 1988, respectively.

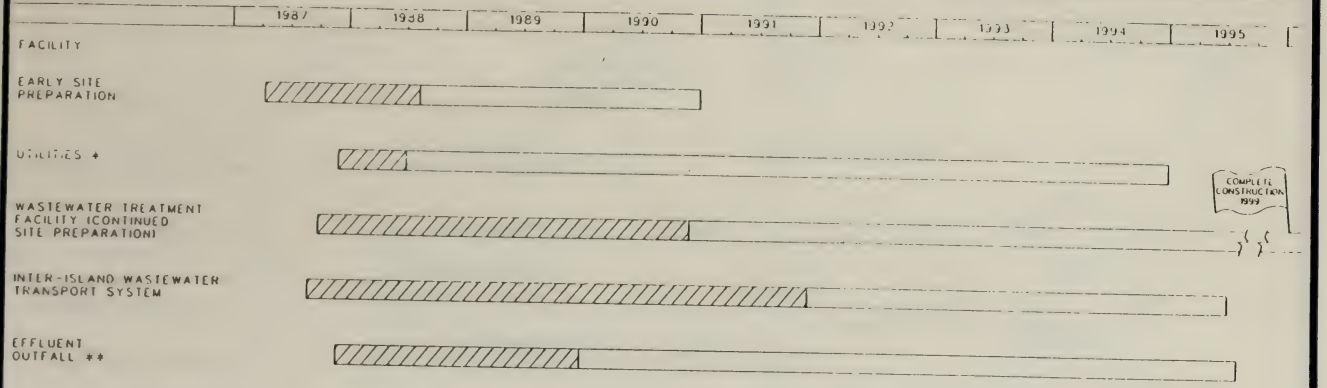
5. Outfall Facilities - Involves the construction of pumping facilities (if required); a tunnel, pipeline, or some combination thereof; and outfall diffuser for the discharge of secondary-treated effluent. These documents will also address the impacts associated with the discharge of primary effluent during the 1995-1999 period of construction for the secondary treatment facilities. The draft and final EID/EIR submittal dates for the Outfall Facilities are November 1987 and March 1988, respectively. The EPA Record of Decision (ROD) on the joint Inter-Island Conveyance/Outfall Facility SEIS is presently scheduled for May 31, 1988.

The identification of the permitting requirements associated with these project components is necessary to ensure consistency with engineering design activities and to support, as appropriate, the court-mandated deadlines for construction. The following sections identify the major federal, state, and local agencies involved in the environmental review and permitting process. For each permit a description of the regulated activity is provided and, as appropriate, keyed to each of the facility development projects. In accordance with current court-mandated construction dates, a preliminary permit/construction schedule is presented in Figure 5.5.1-1.

A preliminary detailed critical path schedule for these projects is proposed in Figures 5.5.1-2 through 5.5.1-6. Major issues involving the need for agency coordination and resolution are also presented along with suggestions for a course of action.

5.5.2 IDENTIFICATION OF RESPONSIBLE AGENCIES AND PERMITS

In accordance with procedures for Environmental Impact Statement/Report review, major permits



NOTES

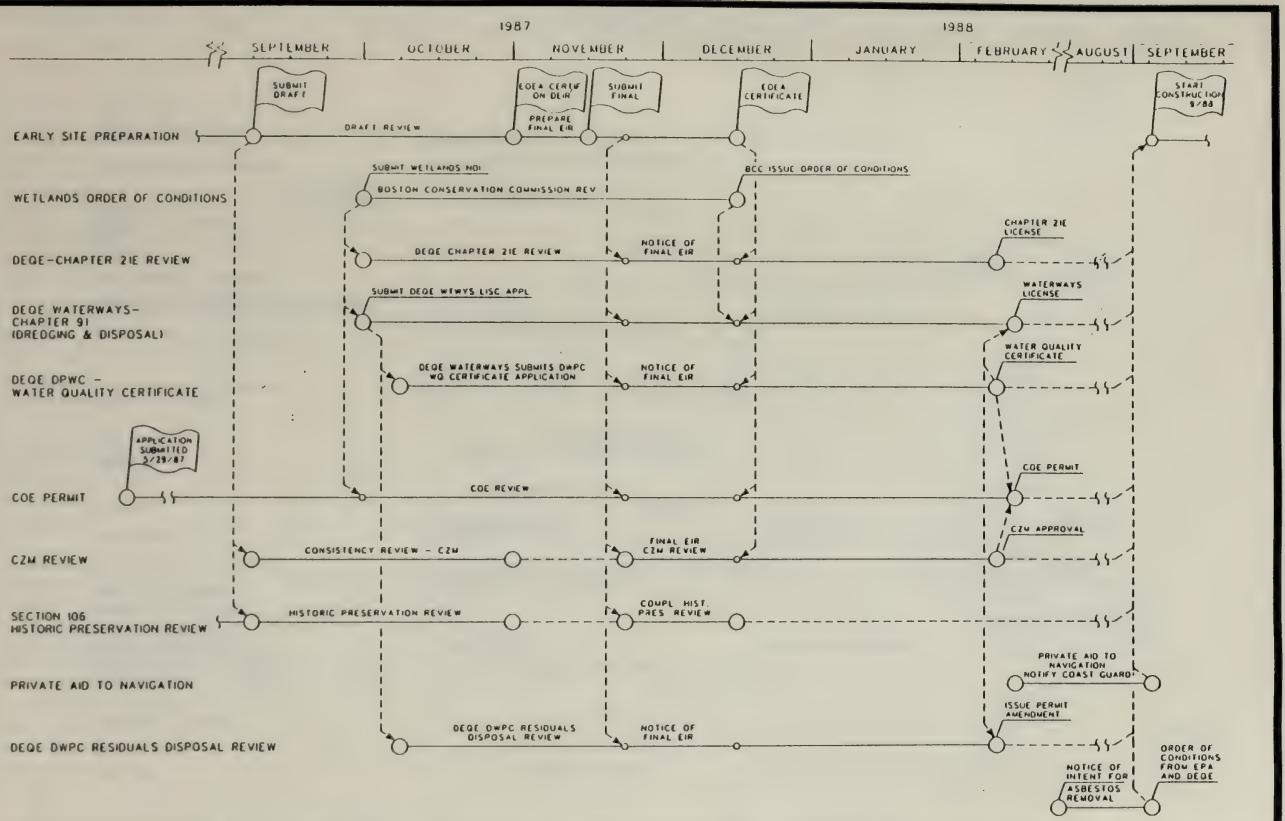
- PERMITTING ACTIVITIES.
- CONSTRUCTION DATES (COURT MANDATED).

*-NO FEDERAL COURT MANDATE, BUT NEEDED AT EARLIEST POSSIBLE DATE TO AVOID DELAYING CONSTRUCTION AND OPERATION OF NEW TREATMENT FACILITIES.

**-CONSTRUCTION SCHEDULE INDICATED IS FOR A NINE-MILE LONG OUTFALL. THIS SCHEDULE CAN BE SHORTENED TO A LATER START DATE FOR PERMITTING OF 4/89 IF A 3 TO 4 MILE LONG OUTFALL IS SELECTED.

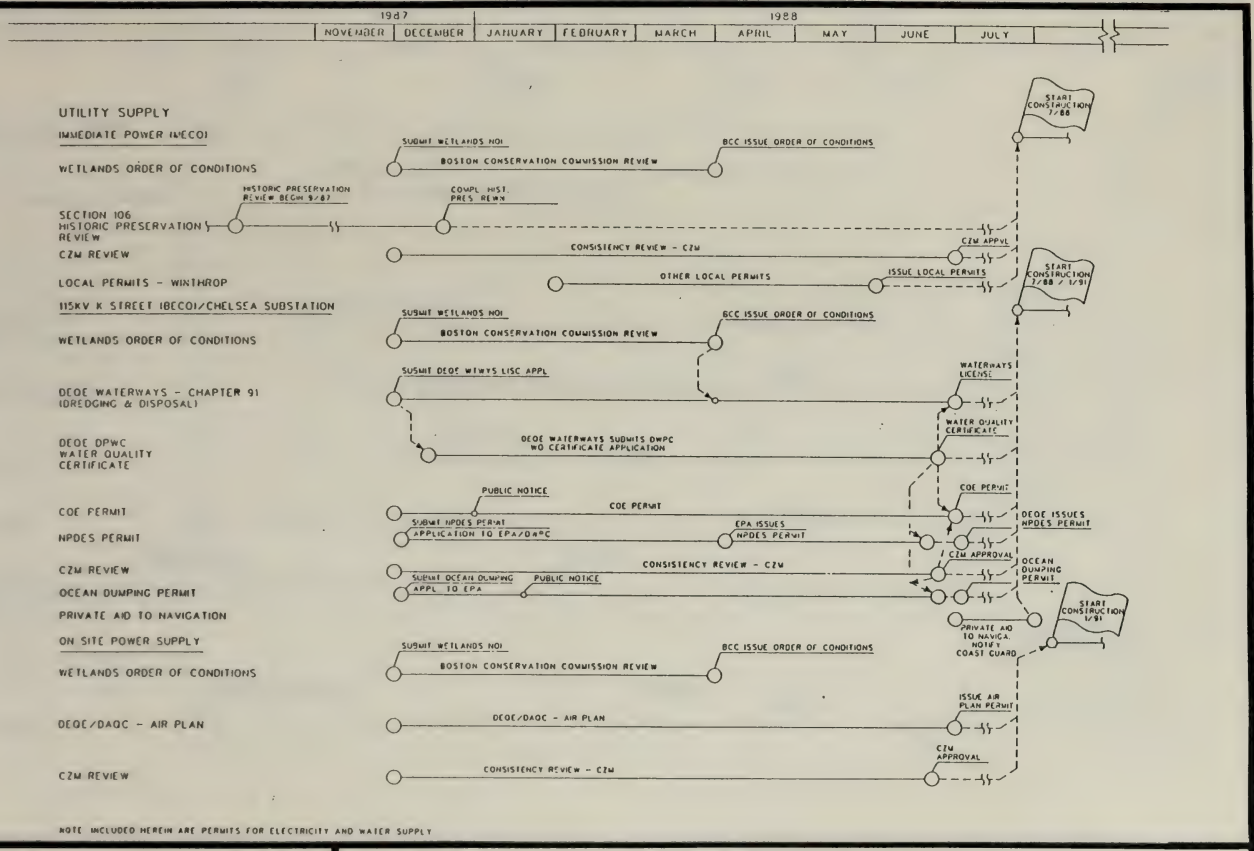
MASSACHUSETTS WATER RESOURCES AUTHORITY

FIGURE 5.5.1-1
SECONDARY TREATMENT FACILITY
COURT MANDATED CONSTRUCTION AND PRELIMINARY PERMITTING SCHEDULE



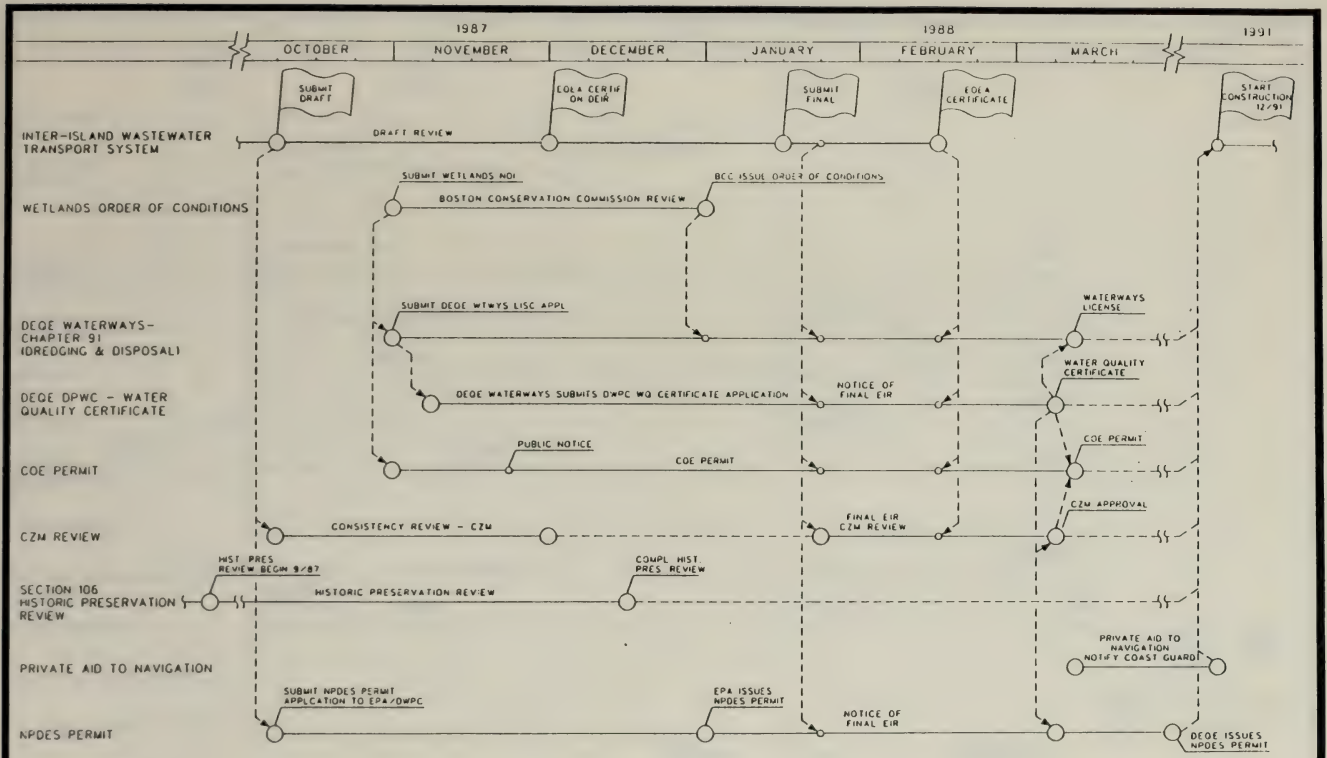
MASSACHUSETTS WATER RESOURCES AUTHORITY

FIGURE 5.5.1-2
PRELIMINARY PERMIT PLAN SCHEDULE
EARLY SITE PREPARATION
DEER ISLAND



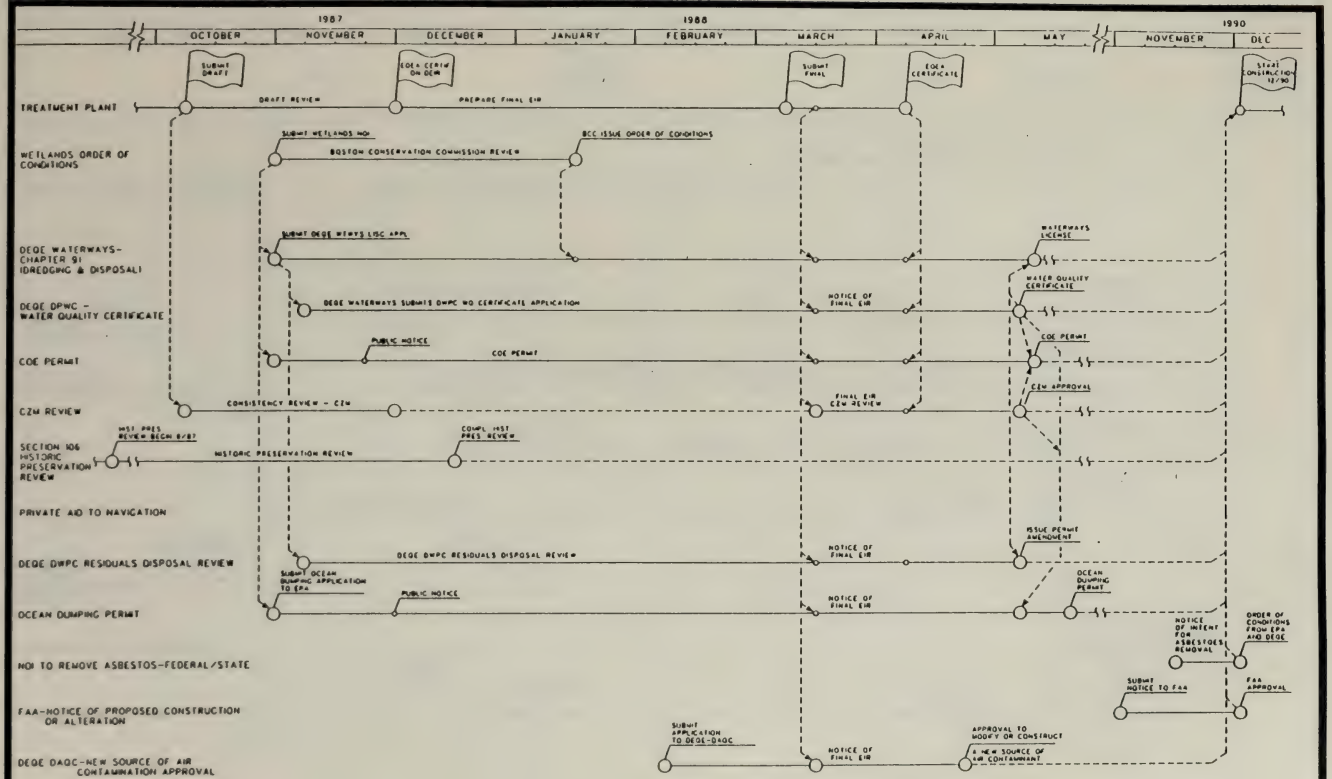
MASSACHUSETTS WATER RESOURCES AUTHORITY

FIGURE 5.5.1-3
PRELIMINARY PERMIT PLAN SCHEDULE
UTILITY SUPPLY
DEER ISLAND



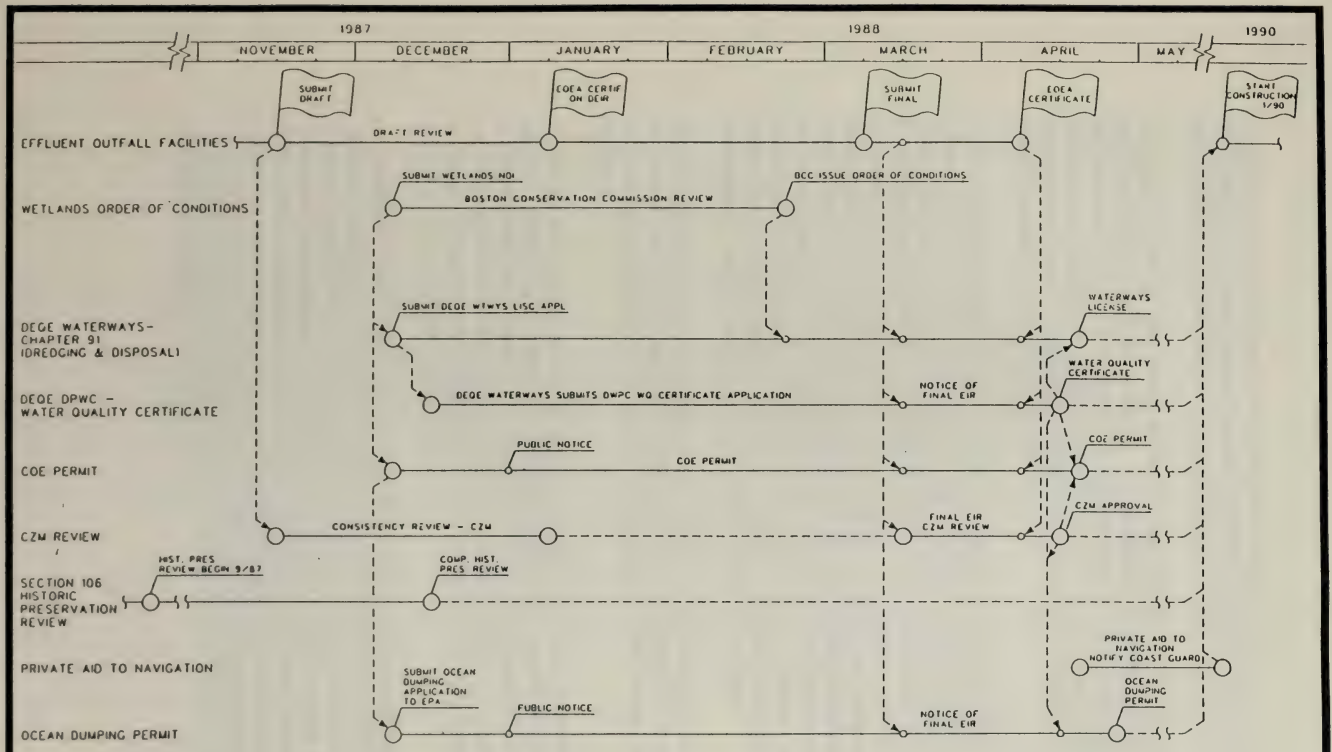
MASSACHUSETTS WATER RESOURCES AUTHORITY

FIGURE 5.5.1-4
PRELIMINARY PERMIT PLAN SCHEDULE
INTER-ISLAND WASTEWATER TRANSPORT SYSTEM
DEER ISLAND



MASSACHUSETTS WATER RESOURCES AUTHORITY

FIGURE 5.5.1-5
PRELIMINARY PERMIT PLAN SCHEDULE
TREATMENT PLANT
DEER ISLAND



MASSACHUSETTS WATER RESOURCES AUTHORITY

FIGURE 5.5.1-6
PRELIMINARY PERMIT PLAN SCHEDULE
EFFLUENT OUTFALL FACILITIES
DEER ISLAND

and approvals must be obtained on the federal level from the Environmental Protection Agency (EPA) and the U.S. Army Corps of Engineers (ACOE). Under the provisions of the National Environmental Policy Act (NEPA), a favorable Record of Decision must be obtained from the EPA.

In conjunction with the EPA review, the ACOE under Section 10 of the River and Harbors Act of 1899, Section 404 of the Clean Water Act, and Section 103 of the Marine Protection, Research and Sanctuaries Act of 1972 is required to assess the impacts of dredging, transport of dredged materials, and discharge or dumping of materials in U.S. or ocean waters. A list of all federal agency permits and approvals required for the Deer Island Secondary Treatment Facilities development is presented in Table 5.5.2-1.

Project approval at the state level is coordinated by the Executive Office of Environmental Affairs (EOEA) under the provisions of the Massachusetts Environmental Policy Act (MEPA). Within the EOEA, major permitting activities are conducted by the Department of Environmental Quality Engineering (DEQE). As shown in Table 5.5.2-1, DEQE has primary responsibility for the permitting of activities involving air and water quality. The National Pollutant Discharge Elimination System (NPDES) permit involving the discharge of treated wastewater is issued jointly with EPA. Other state responsibilities include Coastal Zone Management (CZM) consistency and Section 106 Historic Preservation review under the purview of the EOEA-CZM Program and the Massachusetts Historical Commission (MHC). In addition, concurrent with the completion of facility planning, a site hearing, pursuant to Chapter 83, Section 6 of the Massachusetts General Laws for Sewage Treatment Plants, must be held.

The identification of local permits and approvals in this report is limited to the regulation of activities in or near the designated wetlands. As shown in Table 5.5.2-1, separate Orders of Conditions may be required for project activities proposed within Boston, Quincy, and Winthrop.

In addition to the identification of the applicable permits and responsible permitting agencies, Table 5.5.2-1 indicates the action which may cause a specific project activity to be subject to permit requirements. Detailed descriptions of permit applicability and procedures are provided in the individual permit fact sheets presented in Appendix A of this volume. As evaluated, anticipated permit requirements for each of the five project components described in Section 5.5.1 are presented in Table 5.5.2-2.

As indicated in Table 5.5.2-2, those permits which require significant lead time for application and review include those issued by EPA, ACOE, EOEA, DEQE-Division of Water Pollution Control (DWPC), and the MHC. Given the very short schedule for Early Site Preparation implementation, the associated permitting activities began during the summer of 1987. While no mandates have been set for the necessary provision of utilities, the required completion date of January 1990 for the first phase of the Utility Supply (Immediate Power) activities requires that a similar permitting schedule be initiated almost immediately by BECo. A preliminary permitting schedule for Early Site Preparation and Utility Supply activities is presented in Figures 5.5.1-2 and 5.5.1-3.

TABLE 5.5.2-1

DRAFT
MASSACHUSETTS WATER RESOURCES AUTHORITY
DEER ISLAND SECONDARY TREATMENT FACILITIES PLAN

PERMIT LIST

For the construction and operation of the Deer Island secondary treatment facilities, MWRA must obtain the appropriate permits and approvals from federal, state, and local regulatory agencies. A preliminary list of these permits and approvals is provided below.

PERMIT/APPROVAL	RESPONSIBLE AGENCY OR AUTHORITY	ACTION REQUIRING PERMIT/APPROVAL
Federal		
o NEPA environmental review	EPA	Federal permitting activities such as Facilities Plan Review.
o EIS (prepared by EPA contractor) and FONSI	EPA	EPA plans to prepare separate EIS's for the Outfall and for the Inter-Island Conveyance System.

TABLE 5.5.2-1 (Cont)

PERMIT/APPROVAL	RESPONSIBLE AGENCY OR AUTHORITY	ACTION REQUIRING PERMIT/APPROVAL
o NPDES permit	EPA (joint permit with DEQE/DWPC)	Treated wastewater discharge
o Dept. of the Army (Section 10 of RHA, Section 404 of CWA, Section 103 of MPRSA)	COE	Sediment dredging, construction of structures beyond the mean high water in navigable and territorial waters, discharge of fill below the high tide line, and transportation of dredged material for ocean disposal
o Ocean Dumping (Section 102 of MPRSA)	EPA	Dumping of dredged or excavated materials in designated disposal areas
o FAA Notice of Proposed Construction and Alteration	FAA	Construction of structures within the vicinity of a public use airport
o NOI - Asbestos Removal	EPA	Demolition, if requiring removal of asbestos covered material
o Private Aid to Navigation Permit	Coast Guard	Placement of temporary or permanent floats, moorings, etc. in areas potentially affecting navigation

TABLE 5.5.2-1 (Cont)

PERMIT/APPROVAL	RESPONSIBLE AGENCY OR AUTHORITY	ACTION REQUIRING PERMIT/APPROVAL
State		
o EIR - EOEA Certification of adequacy and compliance with MEPA and NEPA regulations	MEPA unit	State permitting, approval, or funding activities for projects meeting specified threshold criteria
o NPDES permit	DEQE/DWPC (joint permit with EPA)	Treated wastewater discharge (see federal fact sheet in Appendix A)
o Water Quality Certification	DEQE/DWPC	Federal or state permitting activities for actions involving discharges to water such as the wastewater discharge, dredging, and construction of structures in navigable waters
o Chapter 91 Waterways License	DEQE, Division of Waterways	Construction of structures seaward of the high tide line
o Dredging and Disposal of Dredged Material Permit	DEQE, Division of Waterways	Dredging and disposal in Massachusetts tidewaters
o Approval to Modify or Construct a New Source of Air Contaminants	DEQE/DAQC	Construction of new or modified sources of air contaminants (e.g., power generation units, air emissions from wastewater)

TABLE 5.5.2-1 (Cont)

PERMIT/APPROVAL	RESPONSIBLE AGENCY OR AUTHORITY	ACTION REQUIRING PERMIT/APPROVAL
o NOI - Asbestos Removal	DEQE/DAQC	Demolition, if requiring removal of asbestos covered material
o Residuals Disposal Approval	DEQE, DWPC	Closure plans for existing Deer Island grit and screenings landfill
o Hazardous Waste License	DEQE	Collection, storage, treatment, or disposal of hazardous waste encountered during demolition activities
o RCRA POTW Permit-by-Rule	DEQE, DWPC	Acceptance for treatment of a hazardous waste meeting pretreatment requirements. POTW is deemed to have a permit if specified conditions are met.
o CZM Program/Federal Consistency Review	Mass. CZM Program	Federal funding/permitting action for activity located within or affecting the coastal zone of Massachusetts
o Section 106 Historic Preservation Review	MHC	Removal/modification of structures which are eligible for inclusion on the National Register of Historic Places
Local		
o Wetlands Order of Conditions	Boston, Quincy and possibly Winthrop Conservation Commissions	Filling, dredging, removing or altering land in or near water bodies (within 100 ft of the 100-year flood plain).

ABBREVIATIONS

COE	-	U.S. Army Corps of Engineers
CWA	-	Clean Water Act
CZM	-	Coastal Zone Management
DAQC	-	Division of Air Quality Control
DEQE	-	Department of Environmental Quality Engineering
DSHW	-	Division of Solid and Hazardous Waste
DWPC	-	Division of Waste Pollution Control
EIR	-	Environmental Impact Report
EIS	-	Environmental Impact Statement
EOEA	-	Executive Office of Environmental Affairs
EPA	-	U.S. Environmental Protection Agency
FAA	-	Federal Aviation Administration
FONSI	-	Finding of No Significant Impact
MEPA	-	Massachusetts Environmental Policy Act
MHC	-	Massachusetts Historic Commission
MPRSA	-	Marine Protection, Research and Sanctuaries Act
NEPA	-	National Environmental Policy Act
NOI	-	Notice of Intent
NPDES	-	National Pollutant Discharge Elimination System
NR	-	Non-Attainment Review
OCSLA	-	Outer Continental Shelf Lands Act
POTW	-	Publicly Owned Treatment Works
PSD	-	Prevention of Significant Deterioration
RHA	-	Rivers and Harbor Act

TABLE 5.5.2-2

DRAFT
MWRA DEER ISLAND SECONDARY TREATMENT FACILITIES
PROJECT PERMITTING MATRIX

Permit/Approval (Responsible Agency)	Utility Supply** 1	2	3	Early Site Prep.	Inter-Island Tunnel	Treatment Plant	Outfall
Federal							
NEPA EIS/ FONSI* (EPA)	P(3)	P(3)	P(3)	R(1)	R(1)**	R(1)	R(1)**
NPDES (Joint EPA DEQE/DWPC)	N	N	N	N	N	O	O
Activities in Navigable Waters* (COE)	N	R(3)	N	R(2)	R(2)	R(2)	R(3)
Ocean Dumping of Dredged or Excavated Materials* (COE/EPA)	N	R(3)	N	N	N	P(3)	P(3)

TABLE 5.5.2-2

DRAFT
MWRA DEER ISLAND SECONDARY TREATMENT FACILITIES
PROJECT PERMITTING MATRIX
(continued)

Permit/Approval (Responsible Agency)	Utility Suply** 1	2	3	Early Site Prep.	Inter-Island Tunnel	Treat-ment Plant	Outfall
Notice of Proposed Construction (FAA)	N	N	N	N	N	P(1)	N
NOI-Asbestos Removal (EPA)	N	N	N	P(2)	N	P(2)	N
Private Aid to Navigation (USCG)	N	R(2)	N	P(2)	R(2)	N	R(2)
State							
EOEA Certification* (EOEA-MEPA Unit)	R(3)	R(3)	R(3)	R(1)	R(1)	R(1)	R(1)

TABLE 5.5.2-2

DRAFT
MWRA DEER ISLAND SECONDARY TREATMENT FACILITIES
PROJECT PERMITTING MATRIX
(continued)

Permit/Approval (Responsible Agency)	Utility Supply** 1	2	3	Early Site Prep.	Inter-Island Tunnel	Treatment Plant	Outfall
NPDES (Joint with EPA)	N	P(2)	N	P(2)	P(2)	O	O
Water Quality Certification* (DEQE/DWPC)	N	R(3)	N	R(1)	R(1)	R(1)	R(1)
Chapter 91 Waterways License* (DEQE-Waterways)	N	R(3)	N	P(2)	R(2)	R(2)	R(1)
Dredging and Disposal* (DEQE-Waterways)	N	R(3)	N	N	N	P(3)	P(3)

TABLE 5.5.2-2

DRAFT
MWRA DEER ISLAND SECONDARY TREATMENT FACILITIES
PROJECT PERMITTING MATRIX
(continued)

Permit/Approval (Responsible Agency)	Utility Supply** 1	2	3	Early Site Prep.	Inter-Island Tunnel	Treatment Plant	Outfall
New Source of Air Contaminants (DEQE - DAQC)	N	N	R(1)	N	N	R(1)	N
NOI-Asbestos Removal (DEQE-DAQC)	N	N	N	P(2)	N	P(2)	N
Residuals Disposal* (DEQE-DWPC)	N	N	N	R(2)	N	P(2)	N
Water Supply (DEQE)	N	N	N	N	N	N	N
RCRA POTW Permit-by-Rule (DEQE-DWPC)	N	N	N	N	N	N	N

TABLE 5.5.2-2

DRAFT
MWRA DEER ISLAND SECONDARY TREATMENT FACILITIES
PROJECT PERMITTING MATRIX
(continued)

Permit/Approval (Responsible Agency)	Utility Supply** 1	2	3	Early Site Prep.	Inter-Island Tunnel	Treatment Plant	Outfall
CZM Consistency Review (MASS. CZM)	P(2)	R(2)	P(2)	R(2)	R(2)	R(2)	R(2)
Section 106 Historic Preservation Review* (Mass. Hist. Comm.)	P(2)	N	N	R(1)	R(1)	R(1)	R(1)
Chapter 21E Review (DEQE)	N	N	N	R(3)	N	N	N
Local							
Wetlands Order of Conditions* (Boston Quincy. Winthrop Conserv. Comms.)	P(2)	R(2)	P(2)	R(2)	R(2)	R(2)	R(2)

TABLE 5.5.2-2

DRAFT
MWRA DEER ISLAND SECONDARY TREATMENT FACILITIES
PROJECT PERMITTING MATRIX
(continued)

NOTES:

O - Permit Obtained
R - Required Permit
P - Possible Permit Requirement
N - Permit Not Required

Availability of Data for Permit Application
(1) Sufficient Information in EID/EIR
(2) Some New Data Required
(3) Major New Data Requirements

* - Permits Requiring Significant Lead Time
** - To be Addressed in Combined EIS/FONSI
***-1, 2 and 3 refer to the three components of the Utility Supply Plan:
1- Immediate Power (MECO), 2- 115kv K Street and Chelsea Substation,
3- On-site Power

Permitting associated with Early Site Preparation activities will require applications to the ACOE, DEQE, and the MHC in addition to the Environmental Impact Statement/Report for EPA and EOEA. Major permits will include appropriate ACOE Section 10, 404, and 103; DEQE-DWPC residuals disposal and Water Quality Certification; CZM Consistency; MHC Section 106 Historic Preservation; and local Order of Conditions reviews and approvals as described in Table 5.5.2-1 and the attached permit fact sheets. Since no material excavated during the Early Site Preparation activity will be disposed of off-site, no major permitting obstacles are anticipated.

Permitting associated with utility supply may require a number of permits in addition to those identified for Early Site Preparation. As shown on Table 5.5.2-2, provision for the disposal of dredged material and more extensive waterways activities may require more extensive permitting involving ocean dumping or upland disposal of contaminated dredge material.

Permitting activities associated with the other three project components are also presented in Table 5.5.2-2 and Figure 5.5.1-1. Preliminary Permitting Schedules for these three components are presented in Figures 5.5.1-4, 5.5.1-5, and 5.5.1-6.

5.5.3 ISSUES

The major issues regarding the final development of the MWRA Deer Island Secondary Treatment Facility Permitting Plan fall into two general categories. First is the question of how the regulatory agencies will review the various permit applications. Since this project has been designated a "major and complicated" project, it must be determined whether the appropriate permitting agencies will review each permit application with regard to specific project information, or as a whole. In addition, the means by which effective agency coordination can be established on joint permitting activities, such as ocean disposal, need to be further identified. Second, there are a number of key problems which must be addressed before project impacts can be assessed and appropriate mitigating measures identified. These problems include:

- Disposal of on-island and effluent tunnel spoil materials.
- Provisions of off-island utilities (power and potable water).

One of the major considerations which needs to be addressed is the disposal of on-island excavation and effluent tunnel spoils. The options currently being examined for the disposal of approximately 1.0 to 1.7 million cubic yards of soils and tunnel spoils include: reuse at other projects upland disposal; ocean dumping; and Harbor Island disposal in conjunction with the Massachusetts Department of Public Works (MDPW) Central Artery/Third Harbor Tunnel project. Given the magnitude of this problem and the number of agencies likely to be involved in its resolution, it is recommended that discussions involving the EPA, ACOE, EOEA, DEQE, the MDPW, and MWRA be fostered to the fullest extent possible.

5.6 CONSTRUCTION SCHEDULING

As a result of the 1985 United States Environmental Protection Agency lawsuit against the Metropolitan District Commission, the Commonwealth of Massachusetts, and the Boston Water and Sewer Commission, the United States District Court of Massachusetts imposed "major milestones" as long term-target dates for the completion of primary and secondary treatment facilities. The target dates for the construction of the treatment facilities, outfall, and inter-island wastewater conveyance system are as follows:

o	Initiate construction of new primary treatment facilities	12/90
o	Complete Construction and commence operation of new primary treatment facilities	7/95
o	Initiate construction of outfall	7/94
o	Complete Construction of outfall	7/94
o	Initiate construction of inter-island wastewater conveyance system	12/94
o	Initiate construction of secondary treatment facilities	during 1995
o	Complete construction of secondary treatment facilities	during 1999

These target dates formed the basis for the preliminary Summary Project Construction Schedule detailed in Section 11.2 of Volume III of the Facilities Plan. This preliminary schedule shows a logical way of constructing the secondary treatment facilities in accordance with acceptable construction methods and practices to meet the court-imposed schedule target dates. It includes limited provisions for such foreseeable risks as weather, but it does not address such events as worker disputes, strikes, force majeure, etc. These acts, and their impacts on the schedule, will be identified, recorded, and monitored by the Program/Construction Management team. (See Figure 5.1.1-1)

The schedule illustrates the division of the major construction activities into manageable construction packages. The design and bid and award periods for each construction package are phased to allow for the necessary coordination and monitoring of the many contractors to be working on-island at the same time, and to facilitate the ferrying of workers and construction materials from the off-island pier facilities.

The preliminary construction schedule is predicated on the construction of complete, operational treatment zones (i.e. Zones A and B) rather than on the construction of the entire treatment plant in a single project. This type of planning allows for the early completion, operational testing, and acceptance by the Authority of individual parts of the plant.

Prior to the initiation of construction of Zone A of the new primary treatment facilities, extensive site preparation activities must begin on Deer Island as early as 1988 in order to prepare a level platform for the siting of the primary clarifiers. As part of this 1988-1990 early site preparation effort, described in detail in Volume VI of the Facilities Plan, the existing outfall pipes will first be protected against heavy construction equipment and/or loads. The existing grit and screenings will be excavated and hauled to a previously prepared, doubly lined, on-island disposal area. A major portion of the central drumlin will be excavated to begin preparation of the level platform for construction of the primary facilities and preparation for a site for the concrete batching plant. The excess materials will be used on-island to develop visual and noise barrier landforms at the northern end of the island. Existing structures such as Ft. Dawes and the water reservoir atop the drumlin will be demolished, with a new non-potable back-up service water system installed (if necessary). The prison area will be used to begin the construction of the northern landforms. Should the prison still be in operation during 1988-1990, the existing prison recreation area will be relocated to allow for the use of the existing area for disposal of excess materials. The south area, reserved for residuals facilities, will be used to dispose of the remaining excess material.

After completion of the on-island pier facilities, the remainder of the central drumlin will be excavated. By the end of 1990 the concrete batching plant will be completed, the prison facilities demolished if the prison is decommissioned, and construction will begin on the shafts for the inter-island wastewater conveyance tunnel and the outfall tunnel.

In addition, prior to the start of the construction of the primary facilities in December 1990, installation of additional short-term and permanent power supplies will be required to meet the power needs for operating the existing treatment facility and constructing the two submarine tunnels. An immediate power supply will be installed from Massachusetts Electric Company's Winthrop grid by January 1990 to provide 15 MW of power to support tunnel construction activities.

Construction of the first phase of the permanent power facilities, as detailed in Appendix H of Volume III of the Facilities Plan, will begin by January 1, 1990. Completion of the first under harbor 115 kv permanent feeder from Boston Edison Company's K Street station will be accomplished by the end of 1991 to meet the power needs of the primary sludge dewatering facilites, the on-island piers, and basic plant power requirements. The second 115 kv permanent feeder from BECo's Chelsea station, and the recommended combined-cycle on-island power plant, will be completed by January 1995 to meet the needs of the new primary facilities and to satisfy the EPA requirement for an uninterruptible supply, should the tie with the utility fail.

The extensive geotechnical exploration program required to support the 1990 design of the inter-island and outfall tunnels will begin in 1988. Based on the estimated advance rates for the tunnel boring machines, construction of the outfall tunnel must begin in late 1990. This start date will allow the outfall to be operational in July 1995, at the same time that the new primary facilities are placed in service.

Construction of the inter-island tunnel could begin any time from late 1990 to April 1991. This tunnel will be completed in approximately three years.

With the completion of the design of Phase I of the Zone A primary facilities in early 1990, the construction of the Main Pump Station and Winthrop Terminal modifications and the North System Force Main components of the primary treatment system will begin during December 1990. Construction of the new South System Pumping Station to lift South System flows up from the inter-island wastewater conveyance tunnel will also begin in 1990, as will the first phase of the new residuals facilities. The second phase of the site preparation efforts will begin in 1990 to prepare the central island area for the construction of the secondary facilities, construct berms in the north and east areas, and handle the outfall and inter-island tunnel spoils.

Concurrently, the design of the remaining two phases of the Zone A primary facilities and design of the Zone B primary treatment units will continue through the first quarter of 1991. Bidding and award of the construction contracts will allow the remainder of the primary treatment facilities to begin being constructed from early 1991 to 1992.

Construction of the Zone A primary clarifiers (A and B) and associated works will also be staggered. Phase I will be completed by mid-1993. Phase II of the Zone A primary clarifiers will be completed by the end of the 1994, and Phase 3 by the end of 1994. The phased construction of the primary treatment zones will permit the early operation of the completed primary clarifiers in 1994, resulting in improved treatment and the testing of equipment during the warranty period under actual operating conditions.

Construction of Zone B (C and D) primary clarifiers and associated works will be completed by July 1995. Operational testing of the new primary treatment facilities will continue through the remainder of 1995. The Nut Island headworks will be operational in mid-1995 when the new primary facilities are available to treat the South System flows. Phase I of the residuals facilities will also be available at that time.

Phase II site preparation efforts to prepare the central island area for construction of the secondary treatment facilities will be completed by the end of 1995. This will complete the major earth movement activities on the island, as well as tunnel excavation efforts. The excess materials will be used to develop on-island noise and visual barriers or will be transported off-island for disposal. Construction of the Zone A secondary clarifiers will begin in this central area by the end of 1995 in accordance with the court schedule.

The Zone B secondary clarifiers will begin construction in mid 1996. With the completion of the Zone B secondary clarifiers and Phase II residual facilities by the end of the 1999, the new Deer Island Secondary Treatment Plant will be operational. This schedule is only achievable, however, if the following critical path activities are completed on time:

- Implementation of the geotechnical information gathering effort in the spring of 1988 to support the design of the tunnels.

- Demolition and removal of the Hill Prison by 1989, or the use of the reserved residuals area for disposal of excess excavated materials generated during the early site preparation period.

- Removal and reburial of the existing grit and screenings by 1990.

- Provision of an interconnection with MECo's Winthrop grid by January 1, 1990 to meet the immediate power needs of the tunnel construction efforts.

- Completion of the first under-harbor power cable by December 1991, and the on-island combined-cycle power plant by January 1990 to meet both the construction power needs and the operating power needs of the new facilities.

- Completion of outfall construction by July 1995, in time to receive flows from the new primary treatment facility.

Section 6

6.0 PROGRAM MANAGEMENT

6.1 OBJECTIVES

The purpose of this section is to analyze the applicability of various construction management approaches for implementing the Massachusetts Water Resources Authority's (MWRA) multi-billion dollar capital program. This section responds to U.S. District Court Judge Mazzone's directive in the "Long-Term Scheduling Order" of May 8, 1986 to "investigate and evaluate 'construction management' for the facilities construction program in order to provide a basis for determining its efficacy and cost for use in the program."

The analysis and proposed strategies are intended to enable MWRA to meet the following objectives:

- o Expansion of its capability to manage the large, complex projects being developed within its capital program;
- o Maintenance of sufficient agency supervision of these unique projects; and
- o Maintenance of agency's capability to simultaneously manage a sizable, annual capital program of approximately $100 million for system-wide improvements related to repair, renewal and normal replacement needs.

6.1.1 ORGANIZATION OF THE REPORT

The remainder of this section is devoted to defining construction management (CM) services, examining the use of CM in two related construction projects and recommending alternative approaches for consideration by the MWRA. The sections address the following major topics:

6.2, Construction Management, answers the following questions:

- o What is construction management?
- o Why is it needed at MWRA?
- o What services can be provided by a CM team?

6.5, Case Studies Of Two Construction Management Approaches, reviews the use of CMs for the construction of the North River Sewage Treatment Plant by the New York City Department of Environmental Protection and in the proposed construction of the Central Artery/Third Harbor Tunnel by the Massachusetts Department of Public Works. The case studies focus on:

- o Role of the construction management team;
- o Role of the sponsoring agency;
- o Differences in the approaches selected for the two projects.

Section 6.6, Proposed Strategy, recommends alternative approaches which may be utilized by the MWRA based on the following questions:

- o What projects within the MWRA Capital Program may require management by a CM team?
- o What level of supervision and involvement is desired by MWRA?
- o What is the preferred mechanism (organizational structure) for generating effective agency supervision?
- o What services are needed from the CM? Which services will be provided by MWRA? What level of risk is MWRA willing to assume?
- o Is it preferable to select a Lead Design Engineer and Construction Manager in a single procurement?
- o What is the cost of using a CM?

6.2 CONSTRUCTION MANAGEMENT

6.2.1 DEFINITION

The possible definitions of construction management are abundant. In the broadest terms, construction management (CM) is an organized, systematic approach to managing a capital project from its initial conception through placement into service and acceptance by its owner. The CM approach is characterized by the application of organizational techniques for disaggregating a major project into smaller, discrete and more optimally-sized and readily-managed components.

A more precise definition of construction management will vary from project to project as the specific services provided by the CM often differ based on the owners' preferences. The CM can offer all required services from early planning through design, procurement, construction management, start-up and occupancy. Some owners delegate contractual authority to the CM, allowing the CM to select and contract directly with vendors and construction contractors. However, other owners, particularly public authorities, may select a more limited set of activities tailored to their particular needs. These needs are determined primarily by the role sought by the owner and the set of activities the owner prefers to perform with in-house staff, as well as by legal restrictions.

For the purposes of this report, CM is defined to be a total service function beginning after completion of a facilities plan. The "full service" CM manages all of the day-to-day activities of design construction and facility start-up. The range of services provided by a CM is modified by the needs of individual projects.

6.2.2 THE NEED FOR CONSTRUCTION MANAGEMENT AT MWRA

On September 5, 1985, the U.S. Federal District Court, Massachusetts District, ruled that discharges into Boston Harbor were in violation of Federal Clean Water Act requirements, and ordered the Massachusetts Water Resources Authority (MWRA) to develop and implement a program to provide full "secondary" treatment of its wastewater discharges, as required by that law. MWRA developed a project schedule with established milestones and eight months later, on May 8,

1986, U.S. District Court Judge Mazzone issued a "Long Term Scheduling Order," adopting MWRA's "milestone" target dates for carrying out the program.

The September 1985 Federal District Court ruling, and the May 1986 "Scheduling Order" issued by Judge Mazzone, has launched the MWRA on a course that will ultimately result in the expenditure of several billions of dollars. When completed around the turn of the century, the proposed secondary treatment plant and the related project components will constitute one of the largest wastewater treatment systems in the nation. It will also be one of the largest and most complex construction projects ever undertaken in the wastewater treatment industry.

As proposed, the Boston Harbor Clean-Up effort will consist of at least eight major construction projects, several occurring at remote sites. They include:

- o A primary treatment facility at Deer Island;
- o A secondary treatment facility at Deer Island;
- o An inter-island tunnel between Nut Island and Deer Island to convey wastewater from the South System to Deer Island;
- o A pump station on Deer Island to receive South System flows and pump them to treatment facilities on Deer Island;
- o On-shore and on-island piers to serve construction and operations;
- o A new outfall facility for the discharge of treated effluent;
- o Sludge disposal facilities;
- o A new Combined Sewer Overflow (CSO) system.

The actual design and construction of these project components will involve the execution of 25 to 30 or more multi-million dollar contracts, some of which may approach $100-300 million in value. Many of these will, in turn, be further disaggregated into numerous subcontracts. Ultimately, the activities of several dozen contractors, subcontractors, and material and equipment vendors will have to be scheduled, coordinated and tracked to ensure that delays are avoided and that the aggressive court schedule is met.

In any situation, managing numerous large capital projects over a multi-year period would pose a formidable management challenge. However, the complexities of the management tasks faced by MWRA are further compounded by several factors associated with the Boston Harbor Clean-Up Project. These include:

- o Compliance with a strict federal court-ordered project completion schedule;

- Demanding design and construction requirements due to the location of the major facilities on an island in Boston Harbor or underwater;

- The higher-than-normal potential for encountering unforeseen conditions due to the physical nature of the area;

- The requirement that all materials are to be delivered to the Deer Island project sites by water transport;

- A limited area for staging and storing material and equipment at the Deer and Nut Island sites;

- The need to maintain ongoing operations at the existing facilities during construction;

- Extensive environmental impact mitigation requirements;

- Extensive regulatory agency reporting requirements;

- The requirement to manage simultaneously a sizable capital program of related system improvements designed to renew and expand the existing collection system;

- The need to coordinate MWRA's projects with other area projects, particularly the Central Artery/Third Harbor tunnel which has similar and concurrent requirements in terms of labor, construction materials, water transportation and disposal of material;

- The need to control project costs to limit the burden on local rate payers.

Collectively, these factors dictate the necessity of using a sophisticated "construction management" approach for carrying out the major capital projects in a well-coordinated manner. No other approach can be considered to have the same potential for success due to the monumental size of these projects, the massive number of contracts and other logistical factors which will have to be managed, the numerous and unique obstacles that must be overcome, and the overwhelming need to control costs and schedule.

6.3 SERVICES PROVIDED BY A CONSTRUCTION MANAGEMENT TEAM

The full range of services provided by a CM can extend from planning and design through construction and facility start-up. As noted earlier, owners may elect to use the services of a CM for a more limited set of activities depending upon the particular circumstances. For MWRA's needs, the decision whether to use a CM should occur after a facilities plan has been prepared by the Authority's Engineering Division for a specific capital project. The facilities plan will serve as the basis for determining if a project's complexity warrants the use of a CM.

The full range of CM services available for each project phase is described briefly below and summarized in Table 6.3-1.

6.3.1 PLANNING

CM services provided during the planning phase include:

- Development of Preliminary Design Standard(s) -- The CM can prepare detailed design standards by which system configurations will be selected.

- Regulatory Agency Liaison/Environmental Impact Analysis -- The CM can serve as liaison to the regulatory agencies and can factor regulatory requirements into design activities, project scheduling and cost estimating. Programs can be established for complying with information gathering and reporting requirements, or for responding to specific actions dictated by the agencies, such as the need to alter the design to mitigate an unacceptable environmental impact.

- Financial Planning Support -- The CM can support the efforts of in-house-financial staff by providing design and construction costs, calculating cash flow requirements and determining the total amount of financing required to complete construction. Estimates of expected O&M costs can also be prepared and combined with capital costs to generate annual and life cycle costs.

- Preliminary Construction Drawings -- Depending on the requirements of the owner, the CM can provide preliminary construction drawings of the recommended facilities plan to help expedite the project and compress the design phase;

- Conceptual Scheduling -- In the planning phase, the CM will develop a project schedule displaying critical dates. The schedule serves as a tool for identifying project activity interdependencies and determining when individual components activity should be initiated and completed. In this phase, the schedule is developed with limited detail, especially for activities scheduled in the later years. As the project progresses, the schedule is updated with new information on the sequencing activities for each component.

- Public Involvement -- The CM can assist MWRA in continuing the public involvement program which began during facilities planning. The CM can help organize and work with citizen advisory committees, give presentations to local planning and neighborhood groups and prepare materials for public distribution.

6.3.2 DESIGN PHASE

Because it is the period in which the owner's needs are defined in detail, the design phase is vital to a successful construction project and has the greatest potential for cost savings.

TABLE 6.3-1

CONSTRUCTION MANAGEMENT SERVICES

Services	Planning	Design	Construction	Start-up
Develop Preliminary/Design Standards	X	X		
Regulatory Agency and Public Liaison	X	X	X	
Provide Construction Input for Design		X		
Value Engineering	X	X		
Cost Estimating	X	X	X	
Scheduling	X	X	X	X
Financial Planning Support	X	X	X	X
Construction Drawings		X	X	
Bid Packaging		X	X	
Procurement		X	X	
Field Office System		X	X	
Management Information System	X	X	X	X
Site Management			X	X
General Condition Items (Clean-up, barricades, etc.)		X	X	X
Design Coordination		X	X	
Quality Assurance/Quality Control (Inspection)			X	X
Safety Oversight			X	X
Security			X	X
Labor Relations		X	X	
Documentation		X	X	
Change Order Review			X	
Claims Management		X	X	
Contract Administration		X	X	X
Training			X	X
O&M Manuals		X	X	X
Project Close-Out		X	X	X
Testing				X
Facility Start-up				X

Services provided during the design phase include:

- Development of Design Standards -- The CM can produce a set of standardized design criteria which can be used by project engineers in the development of detailed plans and specifications. The standards are used to ensure that all those involved in the project's design, construction, and equipment procurement are cognizant of local, state and federal codes and industry standards of performance;

- Provision of Construction-Related Input into Design -- The integrated approach used by a CM allows construction-related input to be factored into the design of the facility. The CM team will evaluate the design in terms of its impact on construction methods, materials requirements, cost and schedule. To provide this type of review, the CM conducts studies of the area's labor supply, labor practices, local construction methods, and the availability of subcontractors, materials and equipment;

- Value Engineering -- The CM, joined by acknowledged industry experts and owner's representatives, will provide a periodic evaluation of the critical design alternatives. For projects financed partly by the Federal Construction Grants program, value engineering (VE) will be performed according to the Federal Grant requirements. In those cases, the CM will oversee and manage the VE but may not be allowed to conduct the review.

- Cost Estimating -- The CM will update and monitor the capital and O&M cost estimates and cash flow projection prepared by the engineers during the design phase;

- Scheduling -- The CM will update the project schedule created in the planning phase to include the increased level of detail developed in the design phase. Detailed activities for each of the project's components' critical events will be included in the project schedule;

- Permits and Other Approvals--The CM can continue to act as the liaison to the regulatory agencies. In this capacity, the CM will continue to provide input for agency submittals, select design modifications based on a sensitivity to environmental issues and establish a project schedule that recognizes the time needed for permitting activities;

- Contract Packaging -- The CM can be responsible for developing a plan that disaggregates the project into discrete "bid packages." By segregating the project into smaller components, the CM is able to offer smaller bid packages and to manage the project budget and coordinate the flow of work and materials more efficiently at the job sites;

- Procurement -- The CM can proceed with the procurement process by drafting detailed scopes of work for engineering services and, for construction contracts, bid the projects using the required engineering plans and specifications. The CM also can be

responsible for pre-qualifying bidders, conducting pre-bid conferences, evaluating bids and proposals, and recommending firms for award. If desired by the owner, the CM can award the contracts directly. To take full advantage of the phasing concept, the CM often procures long-lead items, so that the equipment and/or material will be available for the contractor, and the use of "like" equipment will be minimized.

- o Design Field Office Support System-- The CM can provide recommendations concerning the provision of temporary facilities, their extent, location and configuration to assure that the needs of the project are met, that duplications do not exist among the various contracts and that all governing laws are satisfied. For large projects involving numerous, dispersed construction sites, the CM is responsible for setting up and staffing field offices and providing the required administrative, technical and information support to each site;

- o Management Information Systems (MIS) -- The CM will create an engineering system that provides up-to-date information on the status of the overall project and individual components. The MIS will provide daily information on the status of the overall project budget and the progress of the master project schedules. The MIS will allow the CM to monitor and track the cost and completion status of each work package, and to target problem areas for immediate attention;

- o Public Involvement -- The CM also can continue to support the owner's program for public involvement and public education. This can include the organization of citizens' advisory committees, publicity programs, presentations to local groups and press releases.

6.3.3 CONSTRUCTION

Services provided during construction include:

- o Construction Site Management -- The CM will provide the project management function at the site, coordinating the activities of several contractors so that construction is mobilized with a minimum of duplication and interference. The major management tool is the development and maintenance of the master project schedule which displays critical events and identifies the interdependencies between project components and subcontractors;

- o Coordination between Design and Resident Engineers -- The CM will provide coordination between the multiple design engineers and contractors, to maintain adherence to design specifications and to modify construction drawings in response to unexpected site conditions;

- o Quality Assurance and Control (QA/QC) -- The CM will develop a Quality Assurance and Quality Control program (QA/QC) for the overall project including the methods and

frequency of inspection that will be used and the pertinent reporting and record-keeping requirements;

- Inspection/Field Office Support -- The CM will staff the necessary field offices with key staff assigned to carry out QA/QC on each major work package. The CM will obtain and install field equipment, particularly those systems required to communicate daily project information to the central CM office for inclusion in the construction management system (MIS) reports;

- Safety Supervision -- The CM will provide supervision of a safety program that complies with federal and state laws, insurance company requirements, local health codes and labor union rules. The program may require the CM to ensure that all contractors provide administrative support, field inspections, and worker awareness programs. In addition, the CM will assist the owner in identifying on-site safety support programs including first aid stations and provisions for ambulance service;

- Security -- The security needs of a construction project are significant and, if not addressed, can become a major source of cost problems. The CM is usually charged with the task of overseeing a security program to ensure that unauthorized individuals do not wander onto the site and injure themselves and that the project's tools, equipment, and building materials are not stolen or vandalized;

- Labor Relations -- CM will coordinate the overall labor relations activities. This requires familiarity with labor supply availability, labor contracts, work rules, and union jurisdictions;

- Review of Shop Drawings and Other Submittals -- The CM will assume overall responsibility for receiving, cataloging and processing all shop drawings, samples, and other submittals from contractors, subcontractors, and engineers;

- Management of Job Records and Documentation -- The CM will establish, maintain and manage project files of records and technical documentation including planning studies, design plans, drawings, accounting records, contracts, correspondence, tests and inspections, and safety records, and provide a system of retrieving data quickly;

- Change Order-- The CM will establish a procedure for receiving, processing and controlling change orders. The procedures are intended to ensure that the change orders are technically justified and economically sound. In making the review, the CM also will consider the secondary impacts of the proposed change in the overall project schedule and budget;

- Construction Claims Management and Mitigation -- The CM will be responsible for maintaining an active and aggressive program to minimize the number of claims. As claims will be unavoidable, the CM will be responsible for maintaining an awareness of

all potential claims and providing information and reports as required to resolve disputes;

- Contract Administration -- The CM can provide administration of construction contracts and purchase orders including overseeing or approving progress payments, processing change orders and resolving claims;

- Approval of Progress Payments -- The CM is usually responsible for overseeing the review, verification and approval of contractor monthly payment estimates. This includes field inspection to verify that the work is of an acceptable quality, conforming with plans and specifications and quality control standards, and completed according to schedule;

- General Conditions Items -- In some cases, the CM can also be responsible for furnishing general conditions items such as general clean-up, security personnel, barnicales and general hoisting and crane facilities;

- Public and Regulatory Agency Liaison -- During the construction phase, the CM will continue to maintain liaison with the public and regulatory agencies to ensure compliance with mitigation measures.

6.3.4 START-UP

Services provided at the point of facility start-up include:

- Responsibility for Project Close-out -- The CM will assume responsibility for: (1) developing specific criteria for determining the final acceptability of contractors' work; (2) establishing dates for equipment testing, acceptance periods, warranty dates and instructional requirements; (3) conducting frequent inspections throughout the finishing stages; (4) obtaining guarantees, warranties, operating manuals and drawings from contractors and vendors; and (5) issuing a certificate of completion of the facility for acceptance by the owner;

- Coordination of Operational Testing and Training of Staff -- The CM also will be responsible for: (1) preparing a start-up program to test, start and bring the plant to an operational level; (2) witnessing the tests of all equipment to judge its compliance with codes, plans and specifications; (3) training the owner's operating staff; and (4) supervising initial operations under the control of a start-up engineer until final acceptance by the owner for operations.

6.4 ADVANTAGES AND DISADVANTAGES OF USING A CONSTRUCTION MANAGER

The full range of services offered by a CM can provide substantial support for completing the agency's project on time and within budget. The use of a CM, however, brings both advantages and disadvantages. The major advantages are the increased program management capability and

the accountability gained by centralizing control within one entity. The major disadvantage in using the full range of services -- particularly for a public agency -- is the potential transfer of a substantial level of control to the CM. The advantages and disadvantages are described briefly below.

6.4.1 THE ADVANTAGES OF CONSTRUCTION MANAGEMENT

Enhanced Program Management Capability

One of the major benefits of the construction management approach is that it brings a program-wide perspective to the overall project. The capable CM brings broad managerial skills and experience to integrate all phases of a project. Most importantly, the CM assumes overall responsibility for properly scheduling and phasing the work to avoid delays, properly scheduling the material and equipment to be delivered on time, and identifying the physical and logistical obstacles to be anticipated and accommodated.

Schedule and Cost Control

The use of a CM provides a central point from which the agency can monitor the overall project budget and master project schedule. The CM brings the latest systems approaches for phasing the project's development and continuously monitoring the project's costs and progress.

State-of-the-Art Design and Construction Techniques

An experienced CM will review the design to ensure that it is compatible with up-to-date design and construction methods. The CM will provide the project's owner with considerable knowledge of the local area construction industry and of the market conditions under which the project will be built. This, in turn, facilitates the CM's ability to develop cost estimates and to refine the overall project budget.

Increased Competition

The disaggregation of the project into smaller, discrete components, or "work packages," increases the number of "projects" that will be put out to bid. The result of making these project components smaller is that more contracting firms can compete, potentially creating a market-induced downward pressure on costs. If needed, the CM also will provide considerable experience in the negotiation of contracts, helping to ensure that the financial benefit of this increased level of competition is captured by the owner.

Economic Incentive Program Benefits

An associated benefit of disaggregating the overall project into smaller work packages is that it enables the program's managers to fashion the construction contracts to take advantage of the capabilities of the local area labor force and construction industry, thus ensuring that an

optimal amount of the economic benefits that are derived from the construction of these projects are captured by the local area contractors.

Dispute Avoidance and Claims Mitigation

A qualified CM will also bring considerable experience in avoiding contract disputes and in mitigating the size of construction claims on the project. Frequently, this will be achieved through direct involvement in the initial stages of the project when scopes of work and contract boiler plate are drafted, and later by developing and maintaining carefully-developed programs for documenting what takes place every day at every level of the project.

In short, the construction management approach, when properly executed, brings a considerable amount of experienced talent to bear on a project from the outset. This can be invaluable in the development and execution of major construction projects. Indeed, the types of errors that can occur in managing multi-million-dollar projects can equal or exceed the cost of the entire project and create a trouble-filled legacy of construction claims and lawsuits that last for years.

6.4.2 THE DISADVANTAGES OF CONSTRUCTION MANAGEMENT

There are also a number of disadvantages in the use of construction management. These include the potential loss of control, the need to maintain liaison with the owner's representatives, additional capital costs, and increased paperwork.

Loss of Control

To fully realize the benefits of the construction management approach, the project's owner effectively relinquishes a great deal of control over the project. The determination of how the project will be organized, its sequence of execution, and day-to-day management will be left to the CM.

Need to Maintain Effective Communication with Owner

Generally, a major construction project is developed by an entity that already has a sizable staff of individuals. Frequently, such individuals will be responsible for managing the new project once it is completed and will likely be involved in the various "owner" decisions that will be made over the course of the project's design and construction. This, in turn, will mean that a process will have to be established and maintained throughout the project's life to exchange information between the owner's staff and the CM.

Additional Costs

For large projects, the construction management process will involve the hiring of a number of very experienced, and therefore highly-paid, individuals. It will also involve the use of sophisticated information and communication handling systems. While some of these costs would

normally be encountered in the execution of a major construction project regardless of who is responsible, there may nonetheless be some additional costs depending on the range of services needed by the owner and the amount of risk the owner asks the CM to assume. The additional costs, however, may be completely offset by effective claims management, successful construction coordination and the ability to maintain the project schedule, thereby reducing inflationary costs.

Increased Paperwork

The use of the construction management approach will also significantly increase the paperwork and record-keeping requirements of the project. The increased number of contractors will inevitably increase the amount of correspondence and other paper-oriented communication that is required to document the owner's instructions and procedural requirements for contractors, vendors, project managers and field inspectors, and others.

The following section describes how two major public works projects were organized to maximize the advantages of using a construction manager while minimizing some of the disadvantages, particularly in the area of "loss of control."

6.5 CASE STUDIES: USE OF A CONSTRUCTION MANAGEMENT TEAM

The organization of construction management teams for two massive public works projects was reviewed to develop possible organizational options for MWRA. The two projects are:

- The North River Water Pollution Control Plant in New York City, managed by the New York City Department of Environmental Protection;

- The Depression of the Central Artery and the Construction of a Third Harbor Tunnel in Boston, managed by the Massachusetts Department of Public Works.

New York City's North River Water Pollution Control Plant was selected for study because it is probably the most expensive wastewater treatment plant under construction and one of the most complex in terms of construction management. The facility, which is projected to cost $1.1 billion when completed in 1989, has been constructed on a relatively small site, with its limited access blocked by a major highway rehabilitation project and with a 30-acre community park built on the roof. Like the proposed MWRA facilities, the project must conform to the milestone dates stipulated in a federal court order.

The Central Artery/Third Harbor Tunnel Project was selected because it is a project of similar scale to MWRA's Deer Island project, is taking place within the same geographic area, has somewhat similar requirements in labor and materials, and faces many of the same logistical issues such as disposal of materials. The MDPW's project is estimated to cost approximately $3.3 billion and is intended to double the capacity of the Central Artery and enable traffic from west and south of Boston to reach Logan Airport without passing through downtown Boston and East Boston.

6.5.1 ORGANIZATION OF THE CM FUNCTION AT THE NORTH RIVER WATER POLLUTION CONTROL PLANT

The organization of the construction management function for the North River Plant is distinguished by the following characteristics:

- The use of "construction management" as an approach which extends from project inception to completion rather than one focusing solely on construction site management;
- The use of an outside team rather than in-house staff for design and construction services;
- The use of the same consultant team for both design and resident engineering services even though the two services were not contracted simultaneously;
- The utilization of the existing divisions within the sponsoring agency to provide overall program management as well as technical input and review of the consultant's products;
- The recognition that design of wastewater treatment facilities is a complex industrial undertaking that requires firms experienced in this specialized field; and
- The retention of significant control by the sponsoring agency in areas such as the authority to issue contracts and change orders.

Each of the characteristics is described more fully below.

Broad Definition of Construction Management

The NYC Department of Environmental Protection (NYC/DEP) recognized that the project's planning and design activities would have a direct impact on the ability to manage construction activities effectively. Construction-oriented personnel were involved in facility planning, design reviews and value engineering.

Perhaps most importantly, construction-oriented individuals prepared the initial Critical Path Method (CPM) schedule and the preliminary cost estimates. NYC/DEP recognized that the pre-bid CPM can identify constructibility and scheduling problems which can be addressed at an early stage. Construction input was sought for the preliminary cost estimates so that unique market conditions -- such as shortages of specialized labor skills or materials and the projected workload of likely bidders -- were factored into the projections.

Use of Consultants

The design and construction management of the North River Plant, because of its size and DEP's workload at the time, were assigned to a design consultant. This decision reflects a recognition of the project's complexities and the level of resources which must be committed by an agency that has substantial ongoing capital and operating responsibilities. The use of outside consultants is particularly significant in the case of NYC/DEP because it may be the only public authority which previously has designed a 300+ mgd plant entirely with in-house staff.

Also significant was NYC/DEP's decision to focus on selecting a design consultant rather than a construction manager. Historically, few construction managers have been involved in the design of wastewater treatment plants. The use of CMs has been more prevalent in tunnel and other civil engineering projects. Conversely, few, if any, experienced designers of wastewater treatment plants have CM experience (in its broadest definition) in large-scale facilities.

Use of the Same Consultant Team for Design and On-Site Construction Management

After using an outside consultant for the design phase, NYC/DEP decided to have the same consultant perform the on-site construction management. The selection reflects two judgments: (1) not to use in-house staff for construction management services and (2) to use the design consultant for construction management services despite the fact that most design firms do not have the CM capability of major construction outfits. In deciding not to use in-house staff, NYC/DEP felt that it had insufficient personnel to staff such a large project. Here again, NYC/DEP, which had substantial experience in providing resident engineering services, felt that it could not allocate sufficient resources to handle a project of the massive size of the North River Plant.* In addition, NYC/DEP recognized that there were many benefits in having the design consultant perform the site work. In a paper presented to the New York Water Pollution Control Association in 1985, Herbert Tschudi, Assistant Commissioner for NYC/DEP's Bureau of Heavy Construction, noted the following advantages of using the same team:

- o There is no need to bring a new consultant "up to speed" on project scope and details;
- o A team familiar with the project can be readily mobilized for any problem;
- o The consultant already has a working relationship with in-house professionals;
- o Design interpretations can be easily obtained, and the firm will be familiar with the project when reviewing as-built drawings.

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* The consultant team eventually assigned an average of 5 individuals to monitor each of the eleven prime contractors.

Retention of Agency Control

As noted earlier, one of the potential disadvantages of a traditional CM approach is the loss of control by the sponsoring agency. In seeking on-site CM services, Mr. Tschudi noted that NYC/DEP took the following approach:

> "What we were looking for is not a true construction management contract, that is, where the CM has complete control over everything, including the authority to issue contracts and change orders. But we wanted more than we had in the past, where a single resident engineer would struggle with a massive project, with limited resources and staff."

Table 6.5.1-1 summarizes the split of responsibilities between the agency and the consultant in the various phases of the North River Plant. In each phase of the project, NYC/DEP elected to maintain overall control, allow its own staff to have input into and some responsibility for the design process, and retained the authority to advertise bids, select contractors, issue change orders and make progress payments. The consultant team assumed primary responsibility for design, cost estimating, scheduling, permits, value engineering, and resident engineering. The consultant also had input on contractor selection, change orders and progress payments, but only NYC/DEP could provide final written approval.

6.5.2 ORGANIZATION OF THE CM FUNCTION FOR THE CONSTRUCTION OF THE DEPRESSED CENTRAL ARTERY/THIRD HARBOR TUNNEL

The organization of the construction management team for the Central Artery/Third Harbor Tunnel Project shares many similarities with, yet has some differences in approach to, the North River Plant project. The similarities are:

- The perception of "construction management" as an approach which integrates design, program management and construction management services rather than an approach focused solely towards on-site construction management;
- The use of outside consultants rather than in-house staff for design and construction services;
- The use of the same team for design and resident engineering services;
- The retention of agency control of areas such as contractor selection, change orders and progress payments.

The ways in which the MDPW approach differs from the NYC/DEP approach are:

- The creation of a special in-house program management group to provide supervision of the consultant team rather than having the consultant interact with the existing structure of the sponsoring agency;

TABLE 6.5.1-1

RESPONSIBILITY MATRIX, AGENCY AND CM TEAM

NYC/DEP NORTH RIVER PLANT PROJECT

(P = Primary Responsibility; I = Input; R = Review)

TASKS	AGENCY	CM
Planning		
Design Standards		
a. Process	P	I
b. Other	I/R	P/I
Alternate Designs	I/R	P
Cost Estimating	I/R	P
EIS	I/R	P
Scheduling	I/R	P
Preliminary Drawings	I/R	P
Public Involvement	I/R	P
Design		
Manage CM Contract	P	-
Interagency Coordination	P	-
Design Standards		
a. Process	P	I
b. Other	P	-
Drawings/Specifications	I/R	P
Cost Estimating	R	P
Scheduling	I	P
Permits	I	P
Value Engineering	I	P
Constructibility	I/R	P
Operability	I/R	P
Plan of Operations	I/R	P

* Based on tables presented in "Construction Management of a Large Water Pollution Control Project: New York City's North River Experience," a paper presented to the 57th Annual Meeting of the New York Water Pollution Control Association on January 22, 1985 by Herbert Tschudi, Assistant Commissioner, NYC Department of Environmental Protection.

TABLE 6.5.1-1

(continued)

TASKS	AGENCY	CM
Construction		
Permits	I/P	P
Advertise/Bid	P	I
Notice to Proceed	P	I
QA/QC	I	P
Vendor Approvals	P	I
Shop Drawings	P	I
Testing	I/R	P
Construction Management	I	P
Change Orders	P	I
Contractor Payments	P	I
Safety	I	P
O&M Manuals	I	P
As-built Drawings	I	P

* Based on tables presented in "Construction Management of a Large Water Pollution Control Project: New York City's North River Experience," a paper presented to the 57th Annual Meeting of the New York Water Pollution Control Association on January 22, 1985 by Herbert Tschudi, Assistant Commissioner, NYC Department of Environmental Protection.

- o The retention of design and construction management services in a single procurement;

- o The extensive use of subconsultants to provide detailed design and construction drawings under the direction of the CM team, after the CM team has completed 10-15 percent of the design for the entire project;

- o The assignment of a representative of the major funding agency to the program management team.

Each of these differences is discussed below in greater detail.

Creation of Special Program Management Office Within the Sponsoring Agency

The MDPW has created an in-house program management group to provide supervision and monitoring of the CM team. The group, which consists of approximately 12 people, has management, technical and support personnel. Team members include a Project Director, legal counsel, administrative support personnel and managers for engineering, structural, utilities/right-of-way and interagency/environmental issues. The responsibilities and organization of the in-house team mirror those of the consultant team for effective interaction. The relationship between the in-house team and consultants is a formal one in which the in-house team reviews consultant reports on key technical decisions and provides written approval.

The advantages achieved by setting up a special office include: (1) identifying and recruiting personnel, both from within the agency and elsewhere, with the skills required for monitoring the project; (2) dedicating individuals to the project rather than involving personnel with multiple responsibilities for ongoing capital and/or operating efforts; and (3) preventing the massive project from consuming the resources of the agency.

Use of a Single Contract for Design/CM Services

Both MDPW and the NYC/DEP arrived at the decision to use the same team for the design and construction phases of their respective projects. MDPW made this judgment at the beginning of the design process and sought an integrated team with multiple capabilities. NYC/DEP, perhaps because of the difficult design requirements associated with secondary treatment facilities, initially procured the team based on its design capabilities and later decided to use the same team for construction management services.

The advantage of the NYC/DEP's approach suggests that MWRA should seek a firm to act as a Lead Engineer in setting the initial design parameters and completing the initial phase of final design. MDPW's approach suggests that MWRA, even if it were to procure a Lead Engineer in addition to a CM, should structure the contract so that one entity is fully accountable for the entire project.

Use of Subcontractors for Design

In the Central Artery/Third Harbor Tunnel Project, the CM has overall responsibility for design but does not actually perform all design functions. The approach is for the CM team to bring the design work to a 10-15 percent level and then to subcontract to "section designers" who will perform under the supervision of the CM team. The approach is especially applicable to highway construction where the design can be segmented into discrete segments. However, the approach may also be effective in designing a wastewater treatment facility in which the integration of various system components is crucial and segmentation of components could lead easily to incompatibility.

Assignment of a Funding Agency Representative

The Federal Highway Administration, the major funder of the CA/THT Project, has assigned an agency representative to be located at the MDPW's CA/THT office. The on-site location of the federal agency representative ensures close coordination with MDPW's program management staff.

6.5.3 COSTS OF CONSTRUCTION MANAGEMENT, NORTH RIVER PLANT AND CA/THT

The cost of using a CM team varies by project depending on the package of services needed by the owners and the level of risk assumed by the CM.

For the North River Plant, NYC/DEP paid a total not-to-exceed cost for CM services of $18 million. This, plus the amount ($9.4 million) set aside for designer services during construction, approached 8.3 percent of the bid totals for the contracts being administered. The CM contract alone represented about 5 1/2% of the bid contract. Design fees, prior to construction, amount to $28 million or roughly 8% of the eventual bid total.

Information is not available on the cost of using a CM for the Central Artery/Third Harbor Tunnel Project.

6.6 PROPOSED STRATEGY

6.6.1 DECISION FACTORS

The organization of construction management services at MWRA must be structured to enable the agency to:

- Manage the largest and most complex projects within its capital program;
- Maintain supervision of the design and construction of these facilities;
- Maintain the capability to manage concurrently an annual capital renewal program of system-wide improvements totaling $100 million.

In determining the preferred way to retain and manage a CM team, the following considerations are felt to be most important:

- What projects within the MWRA Capital Program are unique in size and complexity and thus are candidates for management by a CM team?
- What level of supervision and involvement is desired by MWRA?
- What is the preferred mechanism (organizational structure) for generating effective agency supervision?
- Which services are needed from the CM? Which services will be provided by the MWRA? What level of risk is MWRA willing to assume?
- Is it preferable to select a Lead Design Engineer and Construction Manager in a single procurement?
- What is the cost of using a CM?

Projects Which Merit Use Of A CM

MWRA'S capital program includes at least five (5) projects of the size and complexity which potentially merit the use of a construction manager. These include: (1) all Deer Island-related construction for the primary and secondary treatment plants including any on-island residuals projects; (2) tunnel construction (both the inter-island and the outfall); (3) off-island residuals; (4) CSOs and (5) water supply projects. The sheer number of projects, their individual complexity and total dollar value suggest that MWRA should seek an organizational structure which will allow the agency to coordinate the activities of multiple CMs.

MWRA should use the facilities planning process as the basis for deciding whether a CM should be retained. Upon completion of the facilities plan by MWRA's Engineering Division, the complexity of each project will be understood thoroughly. At that point, the decision to assign the project solely to in-house staff, or to retain a CM, can be made.

The facilities plan for Deer Island is sufficiently completed to recommend strongly that MWRA retain a CM for Deer Island-related construction and a CM for the outfall and inter-island tunnels. Because the on-island residuals facilities will be constructed simultaneously with the treatment facilities, a single CM should direct the on-island activities of both of these programs.

Desired Level Of MWRA Supervision And Involvement

As a public authority, MWRA should seek an organizational approach by which it can transmit the agency's objectives to the CM and monitor the CM's performance, while preserving the many advantages of retaining a CM to handle day-to-day control of the project.

Preferred Organizational Structure

The case studies of the North River Plant and the Central Artery/Third Harbor Tunnel present contrasting approaches to the sponsoring agency's management of the CM. The NYC/DEP had the CM team interface with the agency's existing divisions; the MDPW set up a special program management office.

The MDPW approach appears to be the most applicable to the needs of the MWRA given the need to manage multiple projects of large size and complexity. A separate program management office would prevent the resources of the existing MWRA engineering, construction and operating divisions from being consumed or overwhelmed by the additional burden of managing these large projects. These divisions, therefore, can devote their resources to the Agency's ongoing capital and operating responsibilities.

In addition, creating a separate program management unit gives MWRA the opportunity to recruit, from within and outside the entire agency, individuals with the skills required to oversee these major construction projects.

Services Required From The CM vs. Those Retained By The Agency

The complex logistical requirements of MWRA's large projects necessitate that MWRA obtain a wide scope of program management and technical services from the CM. However, because of its status as a public authority, MWRA will need to maintain control over the bidder process, contractor selection and contract payment. Like any project owner, whether a public or private entity, MWRA also will want to retain overall guidance and monitoring of the CM to ensure that the CM is meeting the agency's objectives.

The service package procured from the CM also depends in large measure upon MWRA's willingness to assume risk for major project components. For example, water transportation and concrete production facilities are necessary services for each contractor working on Deer Island. Which entity -- MWRA, the CM, or the individual general contractor -- assumes the responsibility for ferrying workers or providing concrete? Options include:

- MWRA contracts for ferry services and a constructor and operator of the concrete plant. Both projects are supervised for MWRA by the CM.

- The CM contracts for and manages the two services.

- Individual contractors are responsible for identifying concrete supplies and transporting workers.

The options generate different responsiblities for claims if and when disputes occur. If MWRA passes the risk to others, the price for CM services and construction services will escalate. However, if claims are excessive, the CM and the contractors will likely pursue the owner. If claims are less than anticipated, the benefits will accrue to the risk-takers, the CM or the contractors.

If MWRA assumes some risks -- especially for these two critical components, water transport and concrete production -- the costs of the CM and the contractors will not reflect these extra risks. If claims are less than anticipated, the benefits will accrue to MWRA.

The final allocation of risk should be made during the early stages of the CM's work, following a more comprehensive review by the CM of the risks and costs.

Use of Single Or Separate Contracts For Design And Resident Engineering Services

The MDPW and the NYC/DEP have successfully used different approaches in contracting for design and construction management services. The key ingredient, regardless of the contractual structure, was a recognition by both agencies of the need to integrate construction-oriented individuals into the planning and design process. The specific contractual approach may be dependent on the type of project. For example, MWRA may wish to identify a lead design engineer, in addition to the CM, for the wastewater treatment facilities because the design of the facilities is a highly specialized, industrial design requiring coordination among multiple designers and prepurchase of critical equipment components. For the tunnel work, it is more likely that design and CM capabilities can be found in a single team. However, MWRA also should place considerable emphasis on design capability when selecting the tunnel CM because of the difficulty of the design component.

NYC/DEP's approach was to procure a design team, while MDPW sought a design and construction management team. Given the complexity of the design and construction of Deer Island facilities, MWRA should seek a procurement mechanism that allows it to select the best designer and the best CM without depending on the ad hoc "teaming" of consultant firms to result in a combination of the top designer and top CM on the same team. Separate procurements will prevent MWRA from being forced to compromise on either design or construction capability because of the team arrangements.

However, separate procurements should not force MWRA to assume the added responsibility of supervising two contracts or create ambiguity as to which consultant is ultimately accountable. Each contract should clearly state that the activities of the lead designer will be managed by the CM.

Estimated Cost of Using a CM

The cost of using a CM will vary depending upon the services selected by MWRA. The cost may range from 5 to 10 percent of the total construction bids, excluding design services. The fee will be determined by the size and duration of the project, the risks assumed by the CM, and the services provided by the CM. A CM providing only site engineering services would charge a fee equal to 2-4 percent of the construction costs. For the North River Treatment Plant, the project's complexity resulted in a cost of almost 6 percent, excluding design services during construction. If the CM were to assume coordination of critical facilities, such as concrete batch plant and water transportation, the fee could approach 10 percent, depending on the risk assumed by the CM.

6.6.2 RECOMMENDATIONS

The recommended approach for MWRA to take in the retention and management of CM services is:

Recommendation 1:

- A strong in-house program management capability should be created at MWRA as soon as possible, through the development of a Program Management Unit dedicated to monitoring the Authority's most complex capital projects.

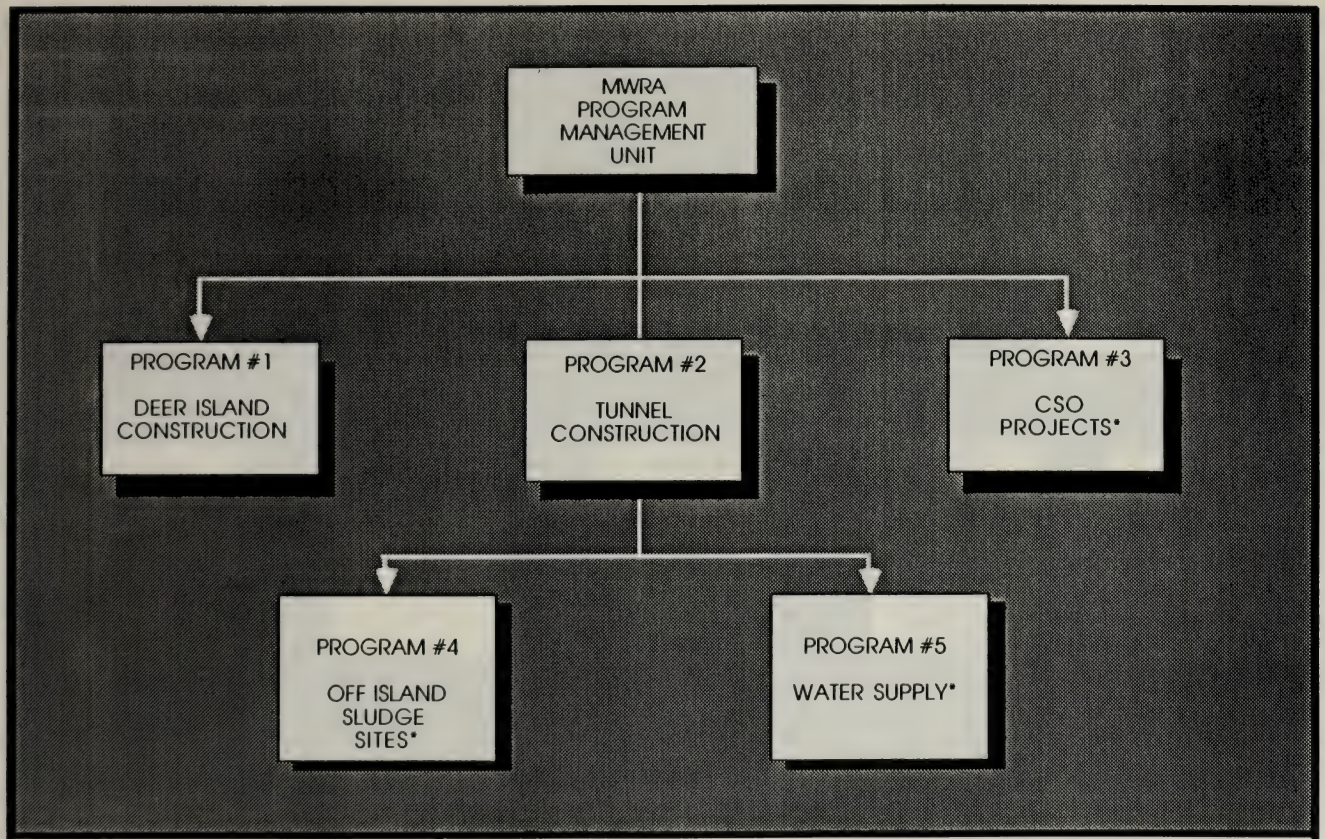
The essential mission of this new unit will be to provide MWRA with control and supervision of its major design and construction projects. The Unit's initial assignment will be to direct all Deer Island construction activities and tunnel work required for the treatment facilities. Separate CMs should be considered for each project. Subsequent assignments might include CSO projects, off-island sludge sites, and water supply projects, depending on the results of MWRA's facilities planning (See Figure 6.6.2-1).

The Program Management Unit should be led by a Director of Program Management with a minimum of 10 years' experience in program and construction management. The Director of Program Management should be a position equivalent in the organizational hierarchy that of to Divisional Director, to help facilitate interagency cooperation and provide policy input to senior management and the Board of Directors.

The unit should be staffed by a small, highly capable team of program managers with expertise in engineering, construction, scheduling, program coordination, law and contract administration (See Figure 6.6.2-2). The duties of each of the managers will include:

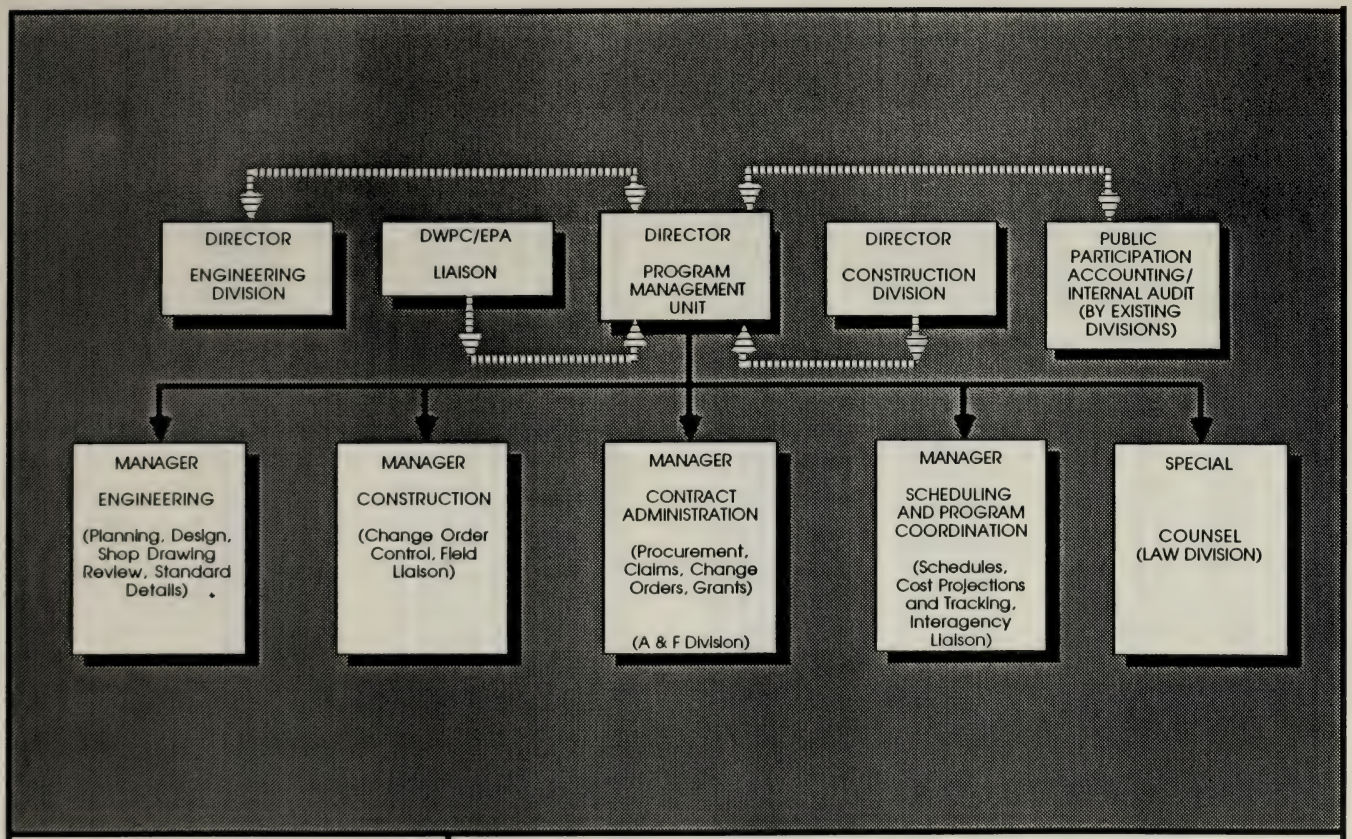
- Manager, Engineering: supervision of planning, design, shop drawing review and standard details.

- Manager, Construction: approval of contract award, review and final approval of change orders, liaison with field engineers, and approval of project close-out



MASSACHUSETTS WATER RESOURCES AUTHORITY

FIGURE 6.6.2-1
TABLE OF MULTIPLE PROGRAM RESPONSIBILITIES
PROGRAM MANAGEMENT UNIT



MASSACHUSETTS WATER RESOURCES AUTHORITY

FIGURE 6.6.2-2
TABLE OF ORGANIZATION
PROGRAM MANAGEMENT UNIT

- o Manager, Scheduling and Program Coordination: monitoring of master project schedule, tracking of project budgets, and interagency liaison.

- o Manager, Contract Administration: on assignment from the Administration and Finance Division to conduct procurements and process claims, change orders and grant receipts through the A&F Division.

- o Special Counsel: on assignment from the Law Division, to provide legal advice on construction contract issues.

In addition to the duties described above, the unit will draw upon existing MWRA divisions for services such as internal audits, accounting and public participation efforts. The division of responsibilities between the program management unit and the CM should be assessed periodically. The Authority may elect to perform additional functions with in-house resources as the capability of the unit increases.

Recommendation 2:

- o The facilities planning efforts of MWRA's Engineering Division should provide the primary information base for determining whether a project requires assignment to the Program Management Unit. Preliminary project planning and more detailed facilities planning should be completed by the MWRA to determine whether a CM approach is needed.

Recommendation 3:

- o The federal and state regulatory agencies should be requested to immediately assign a liaison to the Program Management Unit. One of the major ingredients in the successful completion of MWRA's major capital projects will be the ability to maintain effective liaison with the federal and state regulatory agencies in permitting and mitigation activities. A strong partnership is necessary because the receipt of federal and state funds and permits will be a primary determinant of whether the schedule is maintained. An extremely effective way to ensure close interaction and monitoring of the regulatory process is to assign a liaison from EPA and the State DWPC to the Program Management Unit. MWRA should insist on a dedicated staff from these agencies to expedite the extensive regulatory reviews required for the Authority's capital projects.

Recommendation 4:

- o The services of a construction manager should be retained as soon as possible to direct the day-to-day activities of projects assigned to the Program Management Unit. Separate construction managers should be retained for each program assigned to the division. CM's should assume overall responsibility for design, cost estimating,

scheduling, permitting,value engineering and resident engineering. The CM also should have technical input into agency decisions regarding contractor selection, change orders and progress payment. MWRA would retain full decision-making in these latter issues (Table 6.6.2-1).

Separate CMs should be retained as soon as possible for the Deer Island activities including on-island residuals and the tunnel work. Obtaining the services of a CM immediately will ensure that construction-related concerns will be factored into design and implementation planning.

Recommendation 5:

- MWRA should retain a Lead Engineer and a Construction Manager for the Deer Island construction. The CM should assume supervision of the work of the engineer.

  The characteristics of a wastewater treatment plant necessitate that the project have a Lead Engineer experienced in the design of treatment facilities to devise design guidelines and do the preliminary construction drawings. To maintain accountability in a single entity, however, the Lead Engineer should be managed by the CM (see Figure 6.6.2-3). Separate procurements will enable the MWRA to select the top lead designer and the top CM without having to hope that the "teaming" arrangements caused by a single procurement will result in the best designer and the best CM being on the same team. The contracts with each firm, the Lead Engineer and the CM, will acknowledge that the CM has primary supervision. The Lead Designer will set guidelines, complete 15-25% drawings, subcontract some design components and manage the work of the subcontractors.

Recommendation 6:

- MWRA should retain design and construction services in a single procurement for the tunnel construction. Tunnel projects, unlike treatment plants, have employed a CM approach for many years. Therefore, many CMs are skilled in the design of these large civil projects. In addition, the tunnel design is not likely to require the multiple designers and careful designer coordination required for the treatment facilities. Thus, a Lead Engineer may not be necessary for the tunnel projects.

Recommendation 7:

- MWRA should carefully assess the risk of contracting directly for water transportation and concrete production as well as other key activities to serve all Deer Island contractors. MWRA should require the CM to prepare an early assessment of the risks associated with alternative contractual arrangements for providing essential services on Deer Island. The early need for these services generates additional urgency regarding the procurement of a CM.

TABLE 6.6.2-1

PROPOSED RESPONSIBILITY MATRIX, MWRA AND CM/LE TEAM

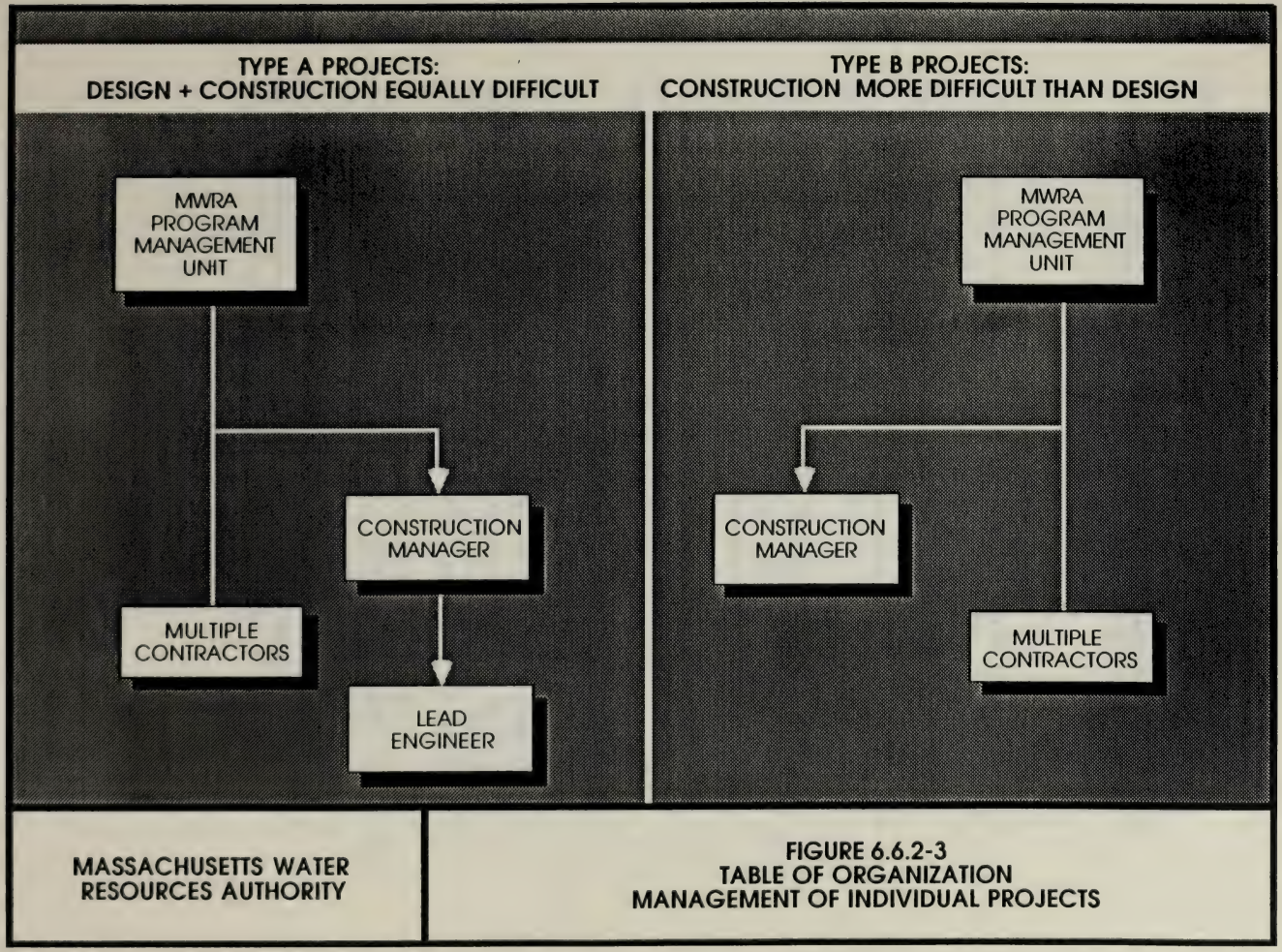
(P = Primary Responsibility; I = Input; R = Review)

TASKS	MWRA	CM/LE
Planning		
Evaluation Criteria	P	I
Regulatory Agency/Public Liaison	I/R	P
Cost Estimating	I/R	P
Scheduling	I/R	P
Preliminary Drawings	I/R	P
Design		
Design Standards	P/I/R	P/I
Drawings/Specifications	I/R	P
Regulatory Agency/Public Liaison	I/R	P
Value Engineering	I	P
Constructibility	I/R	P
Cost Estimating	I/R	P
Scheduling	I/R	P
Financial Planning Support	P	I
Bid Packaging	I/R	P
Procurement	P	I
MIS	I/R	P
Field Office Support System	I/R	P
Temporary Facilities Recommendation	I/R	P
Construction		
Site Management	I/R	P
Coordination Design & Field Engineer	R	P
QA/QC	I/R	P
General Condition Items	I	P
Field Office Support	I/R	P
Safety	I/R	P
Security	I/R	P
Labor Relations	I/R	P
Shop Drawings	P	I/R

TABLE 6.6.2-1

(continued)

TASKS	MWRA	CM
Job Records/Documentation	R	P
Change Orders	P	I/R
Claims Management	I/R	P
Contract Administration	P	I/R
Approval of Progress Payments	P	I
Start-up		
Training	I	P
O&M Manuals	R	P
Project Close-out	R	P
Testing	R	P
Start-up	R	P
Recommend Acceptance	-	P
Final Acceptance	P	I


TYPE A PROJECTS:
DESIGN + CONSTRUCTION EQUALLY DIFFICULT
MWRA PROGRAM MANAGEMENT UNIT
CONSTRUCTION MANAGER
MULTIPLE CONTRACTORS
LEAD ENGINEER
TYPE B PROJECTS:
CONSTRUCTION MORE DIFFICULT THAN DESIGN
MWRA PROGRAM MANAGEMENT UNIT
CONSTRUCTION MANAGER
MULTIPLE CONTRACTORS
MASSACHUSETTS WATER RESOURCES AUTHORITY
FIGURE 6.6.2-3
TABLE OF ORGANIZATION
MANAGEMENT OF INDIVIDUAL PROJECTS

Recommendation 8:

- The capability to manage the remainder of MWRA's sizable capital program should be maintained by continuing to assign these projects to the Engineering and Construction Divisions. The need, if any, to enhance the capacity of these divisions is not addressed in this report.

6.7 CONCLUSION

This report analyzes the potential use of a Construction Management (CM) approach to support the implementation of the major projects within MWRA's capital program. CM is an organized systematic method for managing complex capital projects from the planning and design stages through start-up and acceptance. It differs from traditional on-site construction management by (1) integrating construction-related knowledge into the design and implementation planning process and (2) providing a program-wide perspective and management capability which enhances the probability of timely completion and effective cost control.

The overwhelming logistical requirements and the strict court-mandated timetable associated with the Harbor Clean-Up Program mandate the use of a CM approach to complete the projects, for they will require the careful coordination of numerous contractors, subcontractors, and material and equipment vendors. The coordination is complicated by the location of some major project components on islands or underwater. Furthermore, limited area is available for construction staging; previous mitigation commitments require that building materials must be delivered by water transport; and the possibility of encountering significant unforeseen conditions during construction exists.

The capable CM team will provide MWRA the broad managerial skills, technical expertise and related project experience to integrate all phases of the project and ensure that the numerous physical and logistical obstacles are anticipated and accommodated. The CM will assume primary responsibility for management and coordination of design, cost estimating, prepurchase of equipment, scheduling, permitting, value engineering, resident engineering, facility testing and staff training. In addition, the CM will provide technical support for agency decisions regarding contractor selection, change order control, progress payments and final acceptance.

To maintain control and supervision of the projects managed by the CM, it is strongly recommended that MWRA create, as soon as possible, a small Program Management Unit dedicated to monitoring the agency's most complex capital projects. The unit will be responsible for transmitting the MWRA's objectives to the CM, monitoring the CM's performance and serving as a liaison between MWRA and the CM. The division of responsibilities between the in-house team and the CM should be assessed periodically. As the capability of the MWRA team increases, the Authority may choose to perform additional functions with in-house staff and procure fewer services from the CM.

The advantages achieved by setting up an independent unit include: (1) preventing the largest projects from consuming the resources of divisions which currently have responsibility for designing and implementing a very large capital program; (2) dedicating individuals to the project rather than involving personnel with multiple existing responsibilities; and (3) identifying and recruiting personnel from within and outside MWRA with the skills required for monitoring these macro-projects.

The Unit's initial assignment will be to assist in the immediate procurement and management of the CMs retained for all Deer Island-related construction activities (including the inter-island and outfall tunnel work). Subsequent assignments for other CMs might include CSO projects, off-island sludge sites and water supply projects. The facilities planning studies of MWRA's Engineering Division should provide the essential information which will allow the Unit to determine on a case-by-case basis whether a project's size and complexity merits assignment to the Program Management Unit the use of a CM.

The Program Management Unit should be led by an individual with substantial experience in program and construction management. The unit's staff should consist of capable program managers with expertise in engineering, construction, scheduling and program coordination. Individuals should also be assigned from the Law and Administrative and Finance Divisions to provide expertise on legal issues, procurement and contract administration. An on-site liaison to the unit should be provided by the Federal and State regulatory agencies involved in the environmental review and funding process, to ensure coordination.

The specific structure used by MWRA in retaining CM services may vary by project. For the Deer Island wastewater treatment facilities, MWRA should separately procure a CM and a lead engineering design firm which is managed by the CM. A Lead Designer is necessary in this case because the design of the facilities is a highly specialized, industrial design which will require coordinating a large number of specialized design firms. In addition, the completion of construction on an optimum schedule may require extensive prepurchase of critical equipment components further aggravating the complexity of design. Separate procurements will ensure that MWRA can select the top designer and the top CM without having its choices limited by the teaming arrangements adopted by consultants. However, MWRA should ensure that accountability will reside in one entity by stipulating that the CM oversee the activities of the Lead Designer.

For the tunnel projects, a single CM should be retained separately. MWRA will likely identify, in a single procurement, a CM with the capability to undertake both the design and construction of the inter-island and outfall tunnels. Although the design of the tunnels is a difficult task and, thus, MWRA should place considerable emphasis on design capability when selecting the CM, the tunnel design (unlike a sewage treatment plant) does not require achieving compatibility among industrial processes.

It is strongly recommended that the procurement of CMs occur immediately to foster adequate construction input into the design process. The MWRA can expect to pay a CM a fee equal to 5

to 10 percent of the construction bids. The actual fee will be determined by the range of services desired by MWRA and the amount of risk assumed by the Authority. MWRA should require the CM to prepare an early assessment of the risks and costs associated with alternative contractual arrangements for providing essential services (e.g. concrete batch plant, water transportation) on Deer Island. The early need for these services generates additional urgency regarding the engagement of a CM.

The major recommendations described above are summarized as follows:

- Create and staff an in-house Program Managment Unit as quickly as possible.
- Procure a CM and a Lead Design Engineer for the Deer Island construction (including on-island residuals) at the earliest possible date. The CM should assume supervision of the design engineer.
- Procure a CM for the tunnel (inter-island and outfall) work at the earliest possible date.
- Immediately assess, with the technical input of the CMs, the level of risk to be assumed by MWRA in providing critical services, such as water transportation and the concrete batch plant, for Deer Island construction.
- Request that the Federal and State regulatory agencies assign a liaison to the MWRA's Program Management Unit to ensure a high level of coordination in the permitting activities.
- Base future decisions on whether a project requires a CM on the facilities planning efforts completed by MWRA's Engineering Division.
- Maintain the capability to manage the remainder of MWRA's sizable capital program by continuing to assign these projects to the Engineering and Construction Divisions.

Section 7

7.0 FINANCIAL IMPACT ANALYSIS

7.1 INTRODUCTION

The construction of new facilities to clean up Boston Harbor and provide adequate sewerage service to the Metropolitan Boston area will entail a major financial commitment. In current-day dollars, it is estimated that new MWRA facilities related to these projects will cost approximately $3 billion. Since construction of these facilities will continue through the century, inflation will increase the actual cost. Once the facilities are constructed, the MWRA will have the additional responsibility and cost of operating the new facilities. The funds to construct and operate these facilities, if not derived from external sources (grants), must be recovered through the Authority's charges to member communities. The purpose of this section of the report is to present the estimated impacts on the MWRA of investments in new facilities, and to provide information that will be useful to the MWRA, local community officials and rate payers for their future financial planning.

The MWRA needs to know the potential impact of future construction and operating costs on its cash flow requirements. This information is essential to the Authority's efforts to plan for the most efficient funding methods and recovery of costs.

Since a primary source of revenue will be direct charges to member communities, the local officials in these communities need to know the prospective impact that the construction program will have on charges from the MWRA. Local officials must become aware of the magnitude of future charges so that they can begin to discuss and plan how these charges will in turn be recovered within their own communities.

Finally, the rate payers and tax payers in the local communities need to know the impact of future charges so that they can anticipate and plan for payment of their increased tax bills and/or sewer bills. If they determine that the magnitude of these increases will be large enough, they may wish to begin their own planning for wastewater treatment facilities or processes. It is also important that individuals understand why their bills are increasing and what the money is being used for.

In order to present the financial impacts, the following tasks have been undertaken, and are described in detail in the following sections:

Current Dollar Expenditures describes the expenditures by year, in current dollars, for construction and operation of new and existing facilities.

MWRA Revenue Requirements projects the amounts in future dollars which must be raised by charges on the member communities to retire the debt associated with the construction program, and to pay operating expenses. A base case and four alternatives have been constructed to evaluate the impact of variables such as inflation, grants, and financing on aggregate charges.

Community Allocation/Impacts investigates the impacts of the MWRA charges on users served by two sewerage division customers, the Boston Water and Sewer Commission and the Town of Needham. These two members were selected because they represent a fully self-sufficient local utility, and one which raises some of its wastewater expenses from tax levies. They are representative of the local financing methods in use in the service territory.

7.2 CURRENT DOLLAR EXPENDITURES

This section presents the current-day dollar estimates of capital and operating expenditures for fiscal years 1988 to 2005. The capital expenditures are estimated payments to contractors, consultants and others without regard to sources of funds used to finance these payments. A discussion of the sources of these funds is presented in the next section. The operating expenses are the estimated annual expenses necessary to operate and maintain all MWRA sewerage facilities and associated Authority expenditures.

The current dollar value cash flow estimates are presented by project in Table 7.2-1. The projections for the Deer Island Facilities are based on the following assumptions:

- Cost estimates by construction package at an ENR construction cost index of 4440, fall of 1987.

- A schedule of payments which has been spread out to reflect the Facilities Planning construction schedule, using equal annual payments, unless otherwise known, and presented by MWRA fiscal year.

- Engineering services costs, based on 9.7% of the total costs presented exclusive of CM/LS expenditures. These include (1) 3.2% for resident engineering and inspection which has been spread over the entire construction period in proportion to the construction expenditures plus (2) 6.5% for design engineering which is spread equally over 1989 through 1994, net of a $3 million expense in FY 1988.

- The construction management/lead engineer (CM/LE) costs, representing 5.7% of the total cost estimates (net of engineering services) spread equally over the entire construction period, net of a $2 million expense in FY 1988.

7.2.1 CAPITAL EXPENDITURES

Capital costs have been identified separately for facilities which have been the specific focus of the Deer Island Secondary Treatment Facilities Plan, and other capital projects of the Authority. Costs estimated as part of this facilities plan have been taken from the other volumes of the plan. They include, as an estimate, the more costly of the range of alternatives for the outfall. The costs of other capital projects have been taken from the Authority's 1988 Capital Improvements Program and supporting documentation together with allowances for collection system projects previously identified as part of the EMMA study and

TABLE 7.2-1
NWEA CASH FLOW ANALYSIS
CURRENT DOLLAR CASH FLOW PROJECTION
(VALUES IN $1000)

CONTRACT	FY 1988	FY 1989	FY 1990	FY 1991	FY 1992	FY 1993	FY 1994	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003	FY 2004	FY 2005	TOTALS
Early Site Prep		7,932	7,932																15,864
Bal.-Site Prep 1				2,432	2,433														4,865
Power & Elec. Facil.		12,108	24,215	24,215	12,108														72,646
Mut Readw, Tunnel, PS			14,691	29,382	29,382	29,382	29,382	14,691											146,910
Outfall			35,417	70,833	70,833	70,833	70,833	70,833	35,417										425,000
Prim. Treat-ZAP1				18,727	37,454	37,454	18,727												112,363
Prim. Treat-ZAP2				26,672	53,343	26,672													106,687
Prim. Treat-ZBP3					19,351	38,702	38,702	19,351											116,106
Site Prep. 2				3,878	7,756	7,756	7,756	7,756	3,878										38,782
Secon. Treat-ZA								39,266	78,532	78,532	78,532	39,266							314,126
Secon. Treat-ZB									29,834	59,668	59,668	59,668	29,834						238,670
Site Prep. 3								3,354	6,707	6,707	6,707	6,707	6,707	3,354					40,245
Engineering Services	3,000	15,784	17,807	20,860	22,698	21,987	20,511	5,049	5,020	4,712	4,712	3,435	1,188	109	0	0	0	0	146,873
CM/LR Services	2,000	7,729	7,729	7,729	7,729	7,729	7,729	7,729	7,729	7,729	7,729	7,729	7,729						94,753
Other																			0
Other																			0
Other																			0
Other																			0
TOTALS - DI	5,000	43,553	107,791	204,729	263,089	240,516	193,641	168,029	167,117	157,348	157,348	116,806	45,459	3,463	0	0	0	0	1,873,890
NON-DI PROJECTS																			
-----																			0
-----																			0
-----																			0
-----																			0
-----																			0
Residuals-Site Acquis.			10,000																10,000
Residuals-1995 A/E-Other				8,750	8,750														17,500
Residuals-1995 Construct.					25,000	50,000	50,000	25,000											150,000
Residuals-2000 A/E-Other							5,800	5,800	5,900										17,500
Residuals-2000 Construct.									33,333	66,667	66,667	33,333							200,000
Interc.& PS-Grants	4,770	31,170	26,100	26,100															88,140
Other Int & PS-Ph.1	15,090	8,880	50	50															24,070
Other Int & PS-Ph.2		1,610	1,020	1,020															3,650
Other Int & PS-Ph.3			12,500	12,500															25,000
Other Int & PS-Ph.4					12,050	12,050	12,050	12,050											48,200
Admin/Other			15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	240,000
On Shore/On Isl. Piers	1,900	17,210	15,113																34,223
Transport. Costs			7,484	17,876	15,486	14,476	16,701	13,498	13,231	12,575	9,618	9,478							130,424
Transp. Site Cost	47,170	9,300																	56,470
TOTALS - NON-DI	68,930	68,170	87,267	81,296	76,286	91,526	99,551	71,348	67,465	94,242	91,285	57,812	15,000	15,000	15,000	15,000	15,000	15,000	1,045,177
GRAND TOTALS	73,930	111,723	195,058	286,025	339,374	332,043	293,192	239,378	234,582	251,590	248,633	174,617	60,459	18,463	15,000	15,000	15,000	15,000	2,919,067

an allowance for miscellaneous divisional capital projects and allocated capital projects of the Authority's support divisions. No costs associated with future CSO projects not yet authorized are included in this analysis.

7.2.2 OPERATING EXPENDITURES

The operating expenditures included in this analysis reflect the direct costs of the sewerage division, plus an allocation for Authority administrative and support expense. Current MWRA operating costs are based on the FY 1988 operating budget. These expenses include the operating costs associated with Deer Island and Nut Island, as well as other Sewerage Division expenses including the Director's Office, Water Quality, Maintenance Engineering, Pumping, and Collection System. Allocated Direct Expenses include the Administrative and Engineering operating costs allocated to the Sewerage Division under the current allocation formula.

The existing operating costs for FY 1989 and FY 1990 are based on the MWRA's preliminary estimates of operations and maintenance increases plus projected staffing levels. Existing system costs for FY 1991 and beyond were inflated at the assumed inflation rate.

The construction of new treatment facilities will result in increased operating expenses associated with treatment, transportation operations, and residuals management. In current-day dollars, the cost of primary treatment is estimated to be $23 million, with operations beginning in FY 1995. Secondary treatment operating costs are estimated to add an additional $9 million in current day dollars, beginning in FY 1999. These costs include current operations at Deer and Nut Islands; and will thus replace the projections for existing Deer and Nut Island costs.

To get workers, materials and supplies to offshore facilities, the MWRA will have to construct and operate water transportation facilities. The portion of these costs related to construction will be capitalized, and are thus reflected in the construction costs presented earlier. A portion will also be related to ongoing operations, and have thus been included as additional operating costs. Plans for transport facilities have not been finalized, although estimated costs have been developed by the Transportation Facility Planning Engineers and are presented herein.

Finally, the Authority will be required to treat and dispose of residuals. The plans for residuals treatment and disposal have also not been finalized. The estimates included herein are based on recent bids for interim treatment and disposal through FY 1994, $21 million annually (current dollars) from FY 1995 through FY 1999 for primary residuals, and $40 million annually (current dollars) thereafter for secondary residuals. These estimates were provided by the Residuals Planning Consultant.

7.3 MWRA REVENUE REQUIREMENTS

The net cost of financing the harbor clean-up will ultimately be raised through charges levied by the MWRA on the communities it services. These communities will then collect funds from various local sources to make payments to the Authority. The purpose of this section is to

estimate the annual amounts which the MWRA will raise through its charges.

In estimating the amounts to be raised through charges, several different variables must be considered. These include economic variables, such as anticipated rates of inflation, and financial variables, such as terms and rates for bond issues and the availability of grants-in-aid and/or loans from state and federal governments.

In order to evaluate the range of effects which different assumptions about the variables might produce, a base case and four alternatives have been constructed. The base case represents a prudent scenario: reasonable estimates of future economic and financial variables are made, and grants-in-aid are assumed to be available only to the extent to which these grants have already been firmly committed to the Authority.

For the base case, the following assumptions have been made:

- Construction costs will increase at a compounded rate of 6% per year.

- Operation and maintenance costs will increase at a compounded rate of 5% per year.

- Projects on the State FY 1988 fundable list will get 85% combined federal and state grant reimbursements (assuming that a portion of all projects are ineligible for funding). Grant payments to the Authority will lag by six months the date of the Authority's expenditure.

The projects on the FY 1988 Fundable List include:

  -- Early Site Preparation
  -- On-Island Piers
  -- Off-Island Piers
  -- Wellesley Extension Sewer
  -- Braintree-Weymouth Interceptor
  -- Framingham Extension Sewer
  -- Hingham Pump Station

- Projects not included on the FY 1988 Fundable lists were assumed to receive no grant funds under the base case because (1) current grant authorizations are insufficient to cover all but a small portion of future construction costs, (2) federal appropriations of authorized funds, even in small amounts, are very uncertain and (3) there is extreme competition for grant funds from other communities in the Commonwealth. Although there may be some additional grant funds in years beyond FY 1988, it was deemed prudent to assume none for the base case analysis.

- Bonds will be sold yearly, in amounts sufficient to pay the capital cash flow and debt reserve requirements net of grants-in-aid receipts.

- Bond proceeds to the Authority would represent 85% of the face value of the bonds. This

means that items such as underwriter's discount, bond insurance, capitalized debt service, reserve deposits, coverage, issuance costs, etc. would represent 15% of the face value of the bonds. The remaining 85% would be available to the Authority to finance construction projects.

- Authority revenue bonds would carry an average annual interest rate of 9% and would mature in 30 years. The bonds would be structured for level annual debt service payments.

- The first Authority revenue bonds will be issued in 1990.

- All existing and future short-term borrowings will be rolled over into a long-term (30 year) bond issue in 1990. The amount of the rollover related to wastewater projects is estimated to be $330 million.

- Funds and reserves held by the Authority would earn interest at the rate of 9% per year. These funds and reserves were assumed to include:

  -- An O&M (Operation and Maintenance) reserve equal to 20% of the annual O&M expense

  -- A RRR (Renewal, Replacement and Repair) reserve that will be built up in equal annual increments from $10 million to $50 million by 1995

  -- An Insurance reserve that will be built up in equal annual increments from $2.5 million to $20 million by 1995

  -- A debt service reserve fund equal to the maximum annual principal and interest payments due on any outstanding MWRA revenue bonds.

7.3.1 CASH FLOW REQUIREMENTS

Table 7.3.1-1 presents the inflated annual construction costs and estimated annual grant receipts for each construction package or project. The values in Table 7.3.1-1 represent the base case values under the assumptions outlined above. The cash flow analysis is based on the present day construction cost estimates presented in Table 7.2-1 and increases these costs in future years based on the assumed inflation rate. Assumed federal and/or state construction grants (for those projects on the FY 1988 Fundable list) are deducted from these inflated costs to determine the net cost to the Authority each year. To fund the annual construction costs, it is assumed that the Authority will sell revenue bonds. (In some alternatives examined later, the impact is analyzed under assumed new grant programs for projects not on the Fundable list and/or assuming that the Authority would take advantage of a new State Revolving Loan Program to fund some construction costs.) Figure 7.3.1-1 graphically presents the wastewater-related construction costs and grant receipts by year.

Table 7.3.1-2 presents a summary of cash flow for construction-related costs for the base case scenario. This table presents the net (less grants) construction costs, the estimated amount of

TABLE 7.3.1-1
INFLATED DOLLAR CASH FLOW & GRANT PROJECTION
(VALUES IN $1000)

CONTRACT	FY 1988	FY 1989	FY 1990	FY 1991	FY 1992	FY 1993	FY 1994	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003	FY 2004	FY 2005	TOTALS
Early Site Prep	0	8,912	9,447	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	18,360
Bal.-Site Prep 1	0	0	0	3,070	3,256	0	0	0	0	0	0	0	0	0	0	0	0	0	6,326
Power & Elec. Facil.	0	13,604	28,841	30,571	16,203	0	0	0	0	0	0	0	0	0	0	0	0	0	89,219
Wet Ready, Tunnel, PS	0	0	17,497	37,094	39,320	41,679	44,180	23,415	0	0	0	0	0	0	0	0	0	0	203,184
Outfall	0	0	42,182	89,425	94,791	100,478	106,507	112,898	59,836	0	0	0	0	0	0	0	0	0	606,117
Prim. Treat-ZAP1	0	0	0	23,643	50,123	53,130	28,159	0	0	0	0	0	0	0	0	0	0	0	155,054
Prim. Treat-ZAP2	0	0	0	33,672	71,385	37,834	0	0	0	0	0	0	0	0	0	0	0	0	142,892
Prim. Treat-ZBP3	0	0	0	0	25,896	54,899	58,193	30,842	0	0	0	0	0	0	0	0	0	0	169,831
Site Prep. 2	0	0	0	4,896	10,380	11,003	11,663	12,363	6,552	0	0	0	0	0	0	0	0	0	56,857
Secon. Treat-ZA	0	0	0	0	0	0	0	62,584	132,677	140,638	149,076	79,010	0	0	0	0	0	0	563,986
Secon. Treat-ZB	0	0	0	0	0	0	0	0	50,404	106,855	113,267	120,063	63,633	0	0	0	0	0	454,222
Site Prep. 3	0	0	0	0	0	0	0	5,345	11,332	12,012	12,733	13,497	14,307	7,582	0	0	0	0	76,808
Engineering Services	3,180	17,734	21,208	26,335	30,375	31,189	30,841	8,047	8,481	8,439	8,946	6,913	2,535	247	0	0	0	0	204,470
CM/LR Services	2,120	8,685	9,206	9,758	10,344	10,964	11,622	12,320	13,059	13,842	14,673	15,553	16,486	0	0	0	0	0	148,632
Other	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTALS - DI	5,300	48,936	128,381	258,466	352,072	341,177	291,165	267,813	282,341	281,787	298,694	235,036	96,961	7,829	0	0	0	0	2,895,958
GRANTS - DI	0	3,788	7,803	4,015	0	0	0	0	0	0	0	0	0	0	0	0	0	0	15,606
NET TOTAL - DI	5,300	45,148	120,578	254,451	352,072	341,177	291,165	267,813	282,341	281,787	298,694	235,036	96,961	7,829	0	0	0	0	2,880,352
NON-DI PROJECTS																			
Residuals-Site Acquis.	0	0	11,910	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	11,910
Residuals-1995 A/E-Oth	0	0	0	11,047	11,709	0	0	0	0	0	0	0	0	0	0	0	0	0	22,756
Residuals-1995 Constru	0	0	0	0	33,456	70,926	75,182	39,846	0	0	0	0	0	0	0	0	0	0	219,409
Residuals-2000 A/E-Oth	0	0	0	0	0	0	8,721	9,244	9,968	0	0	0	0	0	0	0	0	0	27,933
Residuals-2000 Constru	0	0	0	0	0	0	0	0	56,316	119,390	126,553	67,073	0	0	0	0	0	0	369,332
Interc.& PS-Grants	5,056	35,023	31,086	32,951	0	0	0	0	0	0	0	0	0	0	0	0	0	0	104,115
Other Int & PS-Ph.1	15,995	9,978	60	63	0	0	0	0	0	0	0	0	0	0	0	0	0	0	26,096
Other Int & PS-Ph.2	0	1,809	1,215	1,288	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4,312
Other Int & PS-Ph.3	0	0	14,888	15,781	0	0	0	0	0	0	0	0	0	0	0	0	0	0	30,669
Other Int & PS-Ph.4	0	0	0	0	16,126	17,093	18,119	19,206	0	0	0	0	0	0	0	0	0	0	70,543
Admin/Other	0	0	17,865	18,937	20,073	21,278	22,554	23,908	25,342	26,863	28,474	30,183	31,994	33,914	35,948	38,105	40,392	42,815	458,646
On Shore/On Isl. Piers	2,014	19,337	18,000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	39,351
Transport. Costs	0	0	8,913	22,568	20,723	20,535	25,112	21,514	22,354	22,520	18,259	19,072	0	0	0	0	0	0	201,571
Transp. Site Cost	50,000	10,449	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	60,449
TOTALS - NON-DI	73,066	76,596	103,936	102,634	102,087	129,832	149,688	113,718	113,980	168,773	173,286	116,329	31,994	33,914	35,948	38,105	40,392	42,815	1,647,093
GRANTS - NON-DI	3,005	26,108	43,964	34,865	14,004	0	0	0	0	0	0	0	0	0	0	0	0	0	121,946
NET TOTAL - DI	70,061	50,488	59,972	67,769	88,083	129,832	149,688	113,718	113,980	168,773	173,286	116,329	31,994	33,914	35,948	38,105	40,392	42,815	1,525,147
GRAND TOTAL - CONST.	78,366	125,532	232,317	361,100	454,159	471,009	440,852	381,532	396,321	450,560	471,980	351,364	128,955	41,743	35,948	38,105	40,392	42,815	4,543,051
GRAND TOTAL - GRANTS	3,005	29,896	51,767	38,880	14,004	0	0	0	0	0	0	0	0	0	0	0	0	0	137,552
GRAND TOTAL - NET	75,361	95,636	180,550	322,220	440,155	471,009	440,852	381,532	396,321	450,560	471,980	351,364	128,955	41,743	35,948	38,105	40,392	42,815	4,405,499

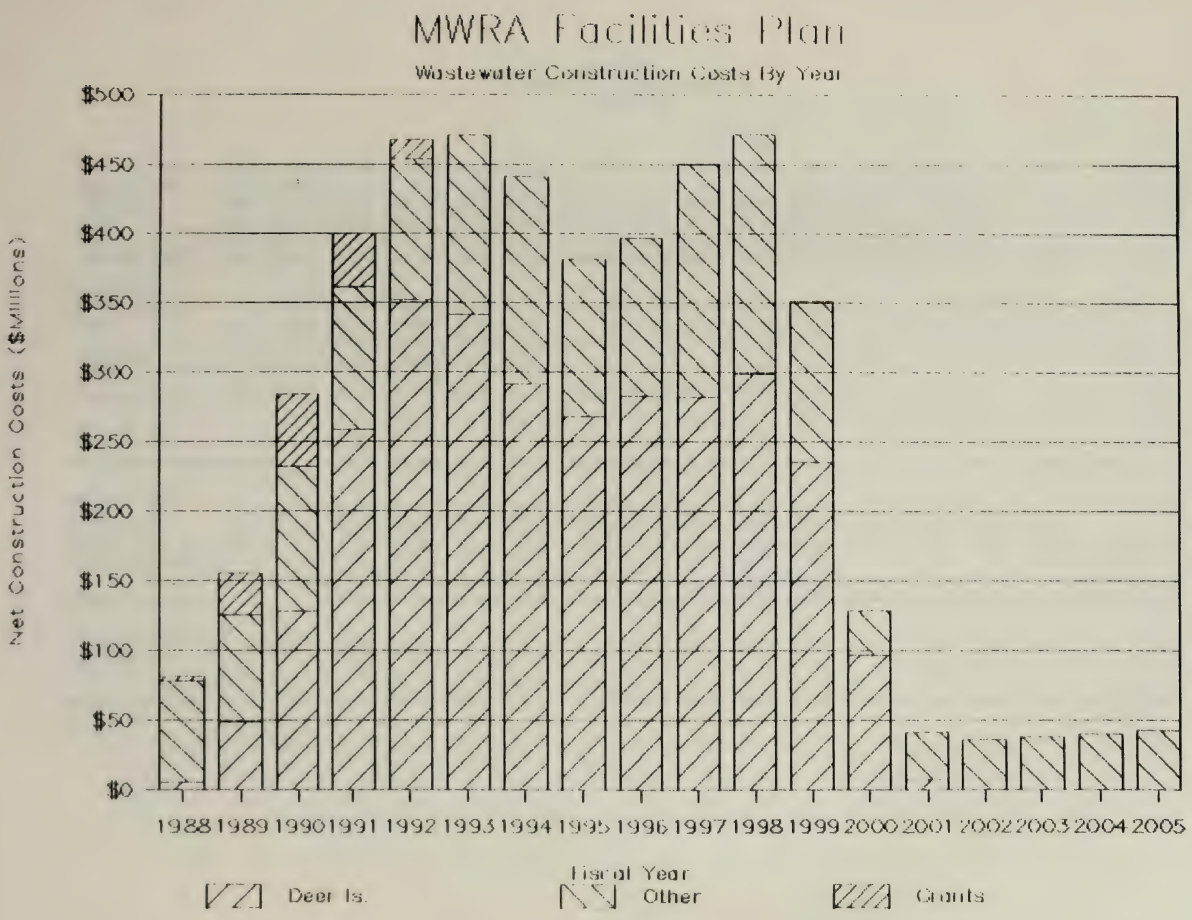

MWRA Facilities Plan
Wastewater Construction Costs By Year
Net Construction Costs ($Millions)
$500
$450
$400
$350
$300
$250
$200
$150
$100
$50
$0
1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005
Fiscal Year
Deer Is.
Other
Grants

FIGURE 7.3.1-1

TABLE 7.3.1-2
CASH FLOW SUMMARY & PROJECTED DEBT SERVICE
(VALUES IN $1000)

	FY 1988	FY 1989	FY 1990	FY 1991	FY 1992	FY 1993	FY 1994	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003	FY 2004	FY 2005
CONSTRUCTION COSTS																		
Deer Island	5,300	48,936	128,381	258,466	352,072	341,177	291,165	267,813	282,341	281,787	298,694	235,036	96,961	7,829	0	0	0	0
Other	73,066	76,596	103,936	102,634	102,087	129,832	149,688	113,718	113,980	168,773	173,286	116,329	31,994	33,914	35,948	38,105	40,392	42,815
TOTAL CONST. COSTS	78,366	125,532	232,317	361,100	454,159	471,009	440,852	381,532	396,321	450,560	471,980	351,364	128,955	41,743	35,948	38,105	40,392	42,815
GRANT AMOUNTS																		
Deer Island	0	3,788	7,803	4,015	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other	3,005	26,108	43,964	34,865	14,004	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL GRANTS	3,005	29,896	51,767	38,880	14,004	0	0	0	0	0	0	0	0	0	0	0	0	0
NET CAPITAL CASH FLOW	75,361	95,636	180,550	322,220	440,155	471,009	440,852	381,532	396,321	450,560	471,980	351,364	128,955	41,743	35,948	38,105	40,392	42,815
AMOUNT - SRF LOAN			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ESTIMATED AMOUNT OF MWRA BOND ISSUES			212,410	379,080	517,830	554,130	518,650	448,860	466,260	530,070	555,270	413,370	151,710	49,110	42,290	44,830	47,520	50,370
MWRA DEBT SERVICE																		
ANNUAL P&I			20,675	57,573	107,977	161,914	212,398	256,088	301,472	353,067	407,115	447,351	462,118	466,898	471,014	475,378	480,004	484,906
EXIST. MA DEBT	10,275	8,943	8,354	7,986	7,760	7,527	7,223	6,994	6,421	6,203	5,730	5,483	4,334	4,150	4,043			
ROLLOVER - EXIST. SHORT-TERM NOTES			31,148	31,148	31,148	31,148	31,148	31,148	31,148	31,148	31,148	31,148	31,148	31,148	31,148	31,148	31,148	31,148
SRF DEBT SERVICE ANNUAL P&I			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GRAND TOTAL DEBT SERVICE			60,177	96,707	146,885	200,589	250,768	294,230	339,041	390,418	443,993	483,982	497,600	502,196	506,205	506,526	511,151	516,054
DEBT SERVICE RESERVE DEPOSITS																		
Local Bonds	0	0	20,675	36,898	50,404	53,937	50,483	43,690	45,384	51,595	54,048	40,236	14,767	4,780	4,116	4,364	4,625	4,903
SRF Bonds			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DS RESERVE FUND BALANCE			20,675	57,573	107,977	161,914	212,398	256,088	301,472	353,067	407,115	447,351	462,118	466,898	471,014	475,378	480,004	484,906

annual Authority revenue bond issues, the Authority's total debt service payments, and annual debt service reserve deposits.

In addition to the impact of construction costs, there will be additional operating and maintenance costs associated with new facilities. The primary treatment facilities are projected to go on line in FY 1995. Operations related to residuals management will start late in FY 1990, and full secondary treatment facilities operations are expected to begin by FY 1999. Transportation operating costs are expected to begin in FY 1989.

Table 7.3.1-3 presents the total estimated annual wastewater operating costs for the Authority. This includes the new operating costs of wastewater and residuals treatment facilities plus the existing costs related to operations at Deer Island, the ongoing operating costs associated with pumping stations and interceptors, and existing indirect operating costs. The indirect costs include administrative and overhead expenses allocated to wastewater utility operations. Figure 7.3.1-2 presents total debt service, operating costs, and reserve deposits by year. These represent the Authority's projected total annual revenue requirements.

7.3.2 ALTERNATIVE SCENARIOS

Because of the sensitivity of some assumed values, alternative cash flow projections were developed to determine the sensitivity of the base case results. Alternatives considered included:

- Alternative inflation rates for construction and operations.

- Varying average annual interest rates on MWRA revenue bonds and varying bond maturities.

- The adoption/resumption of a federal and/or state grant program. If such a program is enacted, it has been assumed that there will be a cap or maximum grant amount that will be available for all Authority projects or construction packages starting in a given year. Accordingly, if the value of all projects beginning in a given year (that is, eligible for grant funds in that year) exceeds the assumed cap, then grants at a lesser rate will result.

- The adoption of a State Revolving Fund (SRF) Program in the Commonwealth. In analyzing the impact of an SRF program, it was assumed that below-market interest rates would be available. Based on federal law, the maturity on SRF's can be no more than 20 years. Like the grant program scenario, a maximum amount of SRF funds was assumed to be available to the authority in any given year. It was assumed that any additional Authority construction costs not paid through loans or the SRF would be paid by Authority revenue bonds.

There are numerous combinations of the different variables that could be analyzed. To limit the number of analyses, various combinations were developed. As discussed earlier, the base case represents the most likely scenario under current conditions. Four additional alternatives were also investigated. Table 7.3.2-1 summarizes the combination of variables used for these four

TABLE 7.3.1-3
PROJECTED OPERATING COSTS & RESERVE DEPOSITS
(VALUES IN $1000)

	FY 1988	FY 1989	FY 1990	FY 1991	FY 1992	FY 1993	FY 1994	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003	FY 2004	FY 2005
EXISTING O&M COSTS																		
DEER ISLAND AND NUT ISLAND																		
WAGES & SALAR.	9,014	10,457	11,853	12,445	13,068	13,721	14,407	15,128	15,884	16,678	17,512	18,388	19,307	20,272	21,286	22,350	23,468	24,641
CHEM. & UTIL.	5,645	6,210	6,831	7,172	7,531	7,908	8,303	8,718	9,154	9,612	10,092	10,597	11,127	11,683	12,267	12,881	13,525	14,201
MAINT.	1,929	2,103	2,292	2,406	2,527	2,653	2,786	2,925	3,071	3,225	3,386	3,555	3,733	3,920	4,116	4,321	4,538	4,764
OTHER	2,103	4,838	5,588	5,868	6,161	6,469	6,792	7,132	7,489	7,863	8,256	8,669	9,103	9,558	10,036	10,537	11,064	11,617
SUBTOTAL	18,692	23,607	26,564	27,892	29,286	30,751	32,288	33,903	35,598	37,378	39,247	41,209	43,269	45,433	47,705	50,090	52,594	55,224
OTHER DIVISION EXPENSES																		
WAGES & SALAR.	9,847	11,422	12,947	13,595	14,274	14,988	15,738	16,525	17,351	18,218	19,129	20,086	21,090	22,144	23,252	24,414	25,635	26,917
CHEM. & UTIL.	512	673	924	971	1,019	1,070	1,124	1,180	1,239	1,301	1,366	1,434	1,506	1,581	1,660	1,743	1,830	1,922
MAINT.	709	773	1,143	1,200	1,260	1,323	1,389	1,459	1,532	1,608	1,689	1,773	1,862	1,955	2,053	2,155	2,263	2,376
OTHER	1,730	1,886	2,555	2,683	2,817	2,958	3,106	3,261	3,424	3,596	3,775	3,964	4,162	4,371	4,589	4,819	5,060	5,312
SUBTOTAL	12,798	14,754	17,570	18,449	19,371	20,340	21,357	22,425	23,546	24,723	25,959	27,257	28,620	30,051	31,554	33,131	34,788	36,527
ALLOCATED DIRECT EXPE	12,130	13,936	15,909	16,705	17,540	18,417	19,338	20,305	21,320	22,386	23,505	24,681	25,915	27,210	28,571	29,999	31,499	33,074
INSURANCE PAYMENTS	841	887	967															
TOTAL EXIST. O&M	44,460	53,184	61,010	63,045	66,198	69,507	72,983	76,632	80,464	84,487	88,711	93,147	97,804	102,694	107,829	113,220	118,881	124,825
EXIST. O&M LESS DIMI	25,768	29,577	34,446	35,153	36,911	38,757	40,695	42,729	44,866	47,109	49,464	51,938	54,535	57,261	60,124	63,131	66,287	69,601
NEW O&M																		
PRIMARY								35,681	37,465	39,338	41,305	43,370	45,538	47,815	50,206	52,716	55,352	58,120
SECONDARY												16,984	17,833	18,725	19,661	20,644	21,676	22,760
RESIDUALS			16,000	40,112	42,117	44,223	46,434	31,027	32,578	34,207	35,917	37,713	75,426	79,197	83,157	87,315	91,681	96,265
TRANSPORTATION		3,955	4,330	4,504	4,729	4,965	5,957	6,340	6,657	7,881	7,158	7,264	7,627	8,009	8,409	8,830	9,271	9,735
TOTAL NEW O&M	0	3,955	20,330	44,615	46,846	49,189	52,391	73,047	76,700	81,426	84,379	105,331	146,425	153,746	161,433	169,505	177,980	186,879
GRAND TOTAL O&M	44,460	57,139	81,340	107,661	113,044	118,696	125,374	115,777	121,565	128,535	133,844	157,269	200,959	211,007	221,558	232,636	244,268	256,481
** RESERVE FUNDS **																		
O&M RESERVE FUND DEPOSIT		2,536	4,840	5,264	1,077	1,130	1,336	(1,920)	1,158	1,394	1,062	4,685	8,738	2,010	2,110	2,216	2,326	2,443
O&M RESERVE BALANCE *	8,892	11,428	16,268	21,532	22,609	23,739	25,075	23,155	24,313	25,707	26,769	31,454	40,192	42,201	44,312	46,527	48,854	51,296
RRR RESERVE FUND DEPOSIT		5,707	5,707	5,707	5,707	5,707	5,707	5,707										
RRR RESERVE BALANCE **	10,054	15,761	21,467	27,174	32,880	38,587	44,293	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000
INSURANCE RESERVE FUND DEPOSIT		2,499	2,499	2,499	2,499	2,499	2,499	2,499										
INSUR. RSRV BALANCE ***	2,506	5,005	7,504	10,003	12,503	15,002	17,501	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000
O&M PLUS RESRV DEPOSITS	44,460	67,880	94,386	121,131	122,326	128,032	134,915	122,063	122,723	129,929	134,906	161,954	209,698	213,017	223,668	234,851	246,594	258,924

* O&M Reserve fund balance assumed to be 20%.
** RRR Reserve funded to reach $50 million balance by 1995.
*** Insurance Reserve funded to reach $20 million balance by 1995.

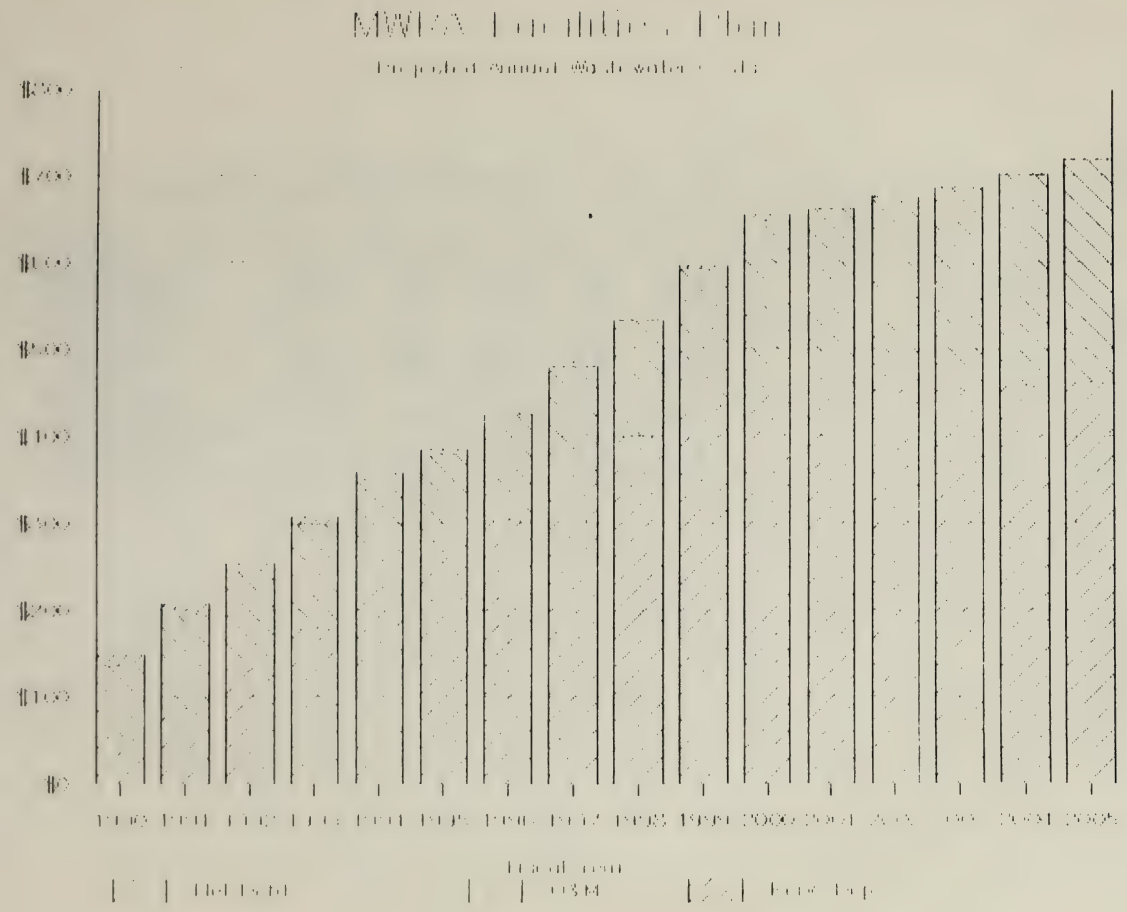


FIGURE 7.3.1-2

TABLE 7.3.2-1
VARIABLES UNDER BASE CASE AND ALTERNATIVES

Variable	Base	Alt. 1	Alt. 2	Alt. 3	Alt. 4
Inflation Rates					
Construction	6.0%	10.0%	6.0%	6.0%	5.0%
Operations	5.0%	9.0%	5.0%	5.0%	3.0%
MWRA Bond Terms					
Term (yrs)	30	20	30	30	30
Interest Rate	9.0%	11.0%	9.0%	9.0%	6.0%
% Proceeds	85.0%	85.0%	85.0%	85.0%	90.0%
Revelov. Funds					
Interest Rate	0.0%	0.0%	4.5%	0.0%	3.0%
Max. Amt./Yr($1000)	$0	$0	$50,000	$100,000	$100,000
Fed/State Grants					
Grant %	0.0%	0.0%	0.0%	0.0%	25.0%
Max. Amt./Yr($1000)	$0	$0	$0	$0	$100,000

alternatives.

- Alternative 1 is similar to the base case, but assumes higher inflation and bond interest rates, plus a shorter term on the Authority's revenue bonds (with high interest rates it is assumed that 30-year bonds cannot be marketed.)

- Alternative 2 uses the base case assumptions, but also assumes the institution of a State Revolving Loan Program with a maximum annual loan amount of $50 million with interest at half the normal market rate.

- Alternative 3 is similar to Alternative 2, but assumes a more attractive State Revolving Loan Program with zero-interest loans and $100 million available per year.

- Alternative 4 is a "best likely case" scenario, assuming lower inflation rates and low interest State Revolving Loan Programs in conjunction with a new grant program of 25% with a maximum grant amount to the MWRA in any given year of $100 million.

Table 7.3.2-2 compares the annual cash flow requirements of the base case with the four alternatives discussed above. Table 7.3.2-3 summarizes the annual revenue requirements under the base case and the alternatives. The annual revenue requirements include:

- The annual wastewater-related operation, maintenance and administrative costs.

- Plus annual debt service expenses on:

  -- Existing Commonwealth general obligation bonds related to debt sold by the MDC but now the responsibility of the MWRA.
  -- The annual principal and interest payments on projected MWRA revenue bonds sold to finance the construction projects.
  -- The annual principal and interest on a MWRA "roll-over" bond. The MWRA is currently financing construction costs through the issuance of short term notes. The total of all existing and future notes is expected to be rolled over into long term bonds in 1990.
  -- Any payments due to the Commonwealth under a State Revolving Fund Loan Program (applicable only in some alternatives).

- Less interest income on projected fund balances. It is assumed that the Authority will establish several funds under future bond covenants. Interest income was assumed to be earned on:

  -- A debt service reserve fund assumed to be equal to one year's principal and interest on all outstanding bonds.
  -- An operation and maintenance fund assumed to have a balance equal to 20% of the annual operation and maintenance costs.
  -- A RRR reserve fund.
  -- An Insurance reserve fund.

TABLE 7.3.2-2
COMPARISON OF NET CAPITAL CASH FLOW
(BASE CASE AND ALTERNATIVES)
(VALUES IN $1000)

	FY 1988	FY 1989	FY 1990	FY 1991	FY 1992	FY 1993	FY 1994	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003	FY 2004	FY 2005
Base Case	75,361	95,636	180,550	322,220	440,155	471,009	440,852	381,532	396,321	450,560	471,980	351,364	128,955	41,743	35,948	38,105	40,392	42,815
Alternative 1	76,318	103,108	202,864	374,729	530,325	588,234	571,348	513,128	553,132	652,560	709,380	548,024	208,721	70,112	62,659	68,925	75,817	83,399
Alternative 2	75,361	95,636	180,550	322,220	440,155	471,009	440,852	381,532	396,321	450,560	471,980	351,364	128,955	41,743	35,948	38,105	40,392	42,815
Alternative 3	75,361	95,636	180,550	322,220	440,155	471,009	440,852	381,532	396,321	450,560	471,980	351,364	128,955	41,743	35,948	38,105	40,392	42,815
Alternative 4	72,591	85,107	155,562	269,664	351,252	361,360	333,575	287,679	307,758	352,973	364,271	259,933	82,933	25,465	26,806	28,773	30,212	31,723

TABLE 7.3.2-3
COMPARISON OF ANNUAL REVENUE REQUIREMENTS
(BASE CASE AND ALTERNATIVES)
(VALUES IN $1000)

	FY 1990	FY 1991	FY 1992	FY 1993	FY 1994	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003	FY 2004	FY 2005
Base Case	148,631	207,372	253,374	307,089	358,750	384,861	426,143	479,957	533,549	596,543	655,789	663,094	677,194	688,106	703,848	720,419
Alternative 1	166,252	251,063	324,998	412,628	500,133	562,617	642,835	744,735	851,547	973,279	1,084,761	1,111,826	1,151,260	1,190,400	1,237,559	1,289,063
Alternative 2	147,264	204,640	249,275	301,623	351,918	376,662	416,579	469,026	521,252	582,880	640,760	646,923	660,041	669,911	684,550	699,951
Alternative 3	143,211	196,531	237,112	285,406	331,646	352,336	388,197	436,590	484,761	542,334	596,159	601,201	613,353	622,199	635,752	650,002
Alternative 4	133,302	173,424	197,759	226,757	254,442	259,035	278,842	308,514	336,812	374,358	413,173	413,999	420,552	423,447	430,631	438,072

7.4 COMMUNITY ALLOCATIONS/IMPACTS

With the significant financial commitment to improve the quality of Boston Harbor's waters there will be major increases in the Authority's sewer charges to the communities it serves. The cost of financing and constructing these facilities (net of grants and other sources of income) will fall on the users within the MWRA service area.

The increased annual sewer charges will not impact all properties to the same degree. MWRA member communities pass the Authority's charges on to their own retail customers in a multitude of ways. These range from full recovery of the Authority charges through the communities' retail sewer rates to full or nearly-full recovery through ad valorem property taxes.

7.4.1 COMMUNITIES ANALYZED

Because of the diversity in retail cost recovery mechanisms employed, the financial impact on users in two different communities has been analyzed. While it is intended that this analysis be useful in determining the relative impact in all communities, it must be recognized that the number of different cost recovery mechanisms used and the diversity among MWRA member communities make a direct comparison between any two communities invalid. The communities selected are:

- Boston. The Boston Water and Sewer Commission (BWSC) is responsible for all retail water, sewer and drainage services in the City of Boston. BWSC is financially independent from the City, and as a result must recover all its costs through its water and sewer rates. The financial impacts in Boston are representative of the impacts in a community that recovers all costs through its retail sewer rate structure.

- Needham. Needham recovers a portion of its sewer-related costs through property taxes, and recovers another portion through direct sewer rate charges to users. The financial impacts in Needham may be representative of the impacts in a community that recovers its costs through a combination of sewer rates and ad valorem property taxes.

7.4.2 BASIS FOR COMMUNITY IMPACT ANALYSES

The Authority is currently reviewing its water and sewer rate methodology. Alternatives to the current method have been identified, and it is possible that the current method, which is based on population and population equivalents, may be revised in the coming years. No new methodology has been approved by the Board, nor is there a general consensus on how the new methodology will be structured. While it is possible that new rate methodologies will impact the various communities quite differently, it is not possible to determine this now. Accordingly, the current methodology and the current (1988) allocation percentages for operating and capital costs have been used to determine the projected future MWRA charges.

The impacts presented for each community are intended to show the total cost of providing wastewater service in that community over the remainder of this century. As such, the costs of

each community's wastewater utility operations include the projected MWRA charges as well as inflation projections of the communities' own current local operating and capital (including debt) costs. The analysis of the future costs and needs in the communities is necessarily not as extensive as that performed for the Authority, and thus may understate the communities' future local costs.

7.4.3 ASSUMPTIONS

To perform the analysis of financial impacts, the following assumptions were made:

- Local operating costs will be affected by inflation in the same manner as the MWRA's operating costs, and would thus increase annually by the same inflation factor.

- There would be no change (unless otherwise identified) in the communities' current cost recovery philosophies and/or practices. For example, BWSC would maintain its current 10-step inclining block rate structure and increase all rates by the same percentage to recover increasing costs. We also assumed that costs recovered through property taxes would continue to be recovered through this mechanism throughout the period analyzed.

- There would be no significant change in a community's customer base -- that is, there would be no increase in water/wastewater customers over which increased costs could be spread. Water use was assumed to remain stable throughout the period.

- The total valuation of property in a town would increase annually by 8% to account for inflation and limited growth.

- The valuation of a typical property would increase annually by 5%.

To show the impact on customers in the two communities, the projected annual sewer bills are shown for several types of customers. In Needham, where some wastewater system costs are recovered through ad valorem property taxes, the annual property tax impact on users is also estimated.

Since a portion of the total annual sewer bill is related to local expenses and another portion is related to MWRA charges, the breakdown of estimated local and MWRA expense impacts is also presented.

7.4.4 FINANCIAL IMPACT ON BWSC

The estimated financial impact on The Boston Water and Sewer Commission is presented on Table 7.4.4-1. This table presents the base case projection of BWSC's own local capital and operating costs based on its 1987 expenses. Projected MWRA charges have been added to determine the total of BWSC's wastewater-related costs that must be recovered through its local sewer rates.

Table 7.4.4-2 presents the base case projections of BWSC's retail sewer rate schedule through the year 2005 and the projected annual sewer bills for three types of users:

TABLE 7.4.4-1
PROJECTED EXPENSES - BOSTON WATER & SEWER COMMISSION
(VALUES IN $1000)

	1987	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
EXPENSES																	
Operating *	13,372	15,480	16,254	17,066	17,920	18,816	19,757	20,744	21,782	22,871	24,014	25,215	26,476	27,799	29,189	30,649	32,181
Indirect *	2,920	3,380	3,549	3,727	3,913	4,109	4,314	4,530	4,756	4,994	5,244	5,506	5,781	6,070	6,374	6,693	7,027
Renewal & Replace.*	1,855	2,147	2,255	2,368	2,486	2,610	2,741	2,878	3,022	3,173	3,331	3,498	3,673	3,856	4,049	4,252	4,464
Bill Adjustants *	2,320	2,686	2,820	2,961	3,109	3,264	3,428	3,599	3,779	3,968	4,166	4,375	4,593	4,823	5,064	5,317	5,583
Bad Debt Allow. *	370	428	450	472	496	521	547	574	603	633	664	698	733	769	808	848	890
Reserve Deposits *	1,594	1,845	1,938	2,034	2,136	2,243	2,355	2,473	2,596	2,726	2,863	3,006	3,156	3,314	3,480	3,653	3,836
Local Debt **	8,050	7,050	7,050	7,050	7,050	7,050	7,050	7,050	7,050	7,050	7,050	7,050	7,050	7,050	7,050	7,050	7,050
Subtotal	30,481	33,017	34,315	35,678	37,110	38,613	40,191	41,848	43,588	45,415	47,333	49,347	51,462	53,682	56,014	58,462	61,033
MWRA Operating	-	30,148	38,690	39,072	40,895	43,093	38,988	39,199	41,500	43,090	51,730	66,979	68,040	71,442	75,014	78,764	82,703
MWRA Capital	-	16,133	25,649	38,975	53,254	66,571	78,159	90,241	104,103	118,562	129,252	132,673	133,859	134,884	134,804	135,993	137,255
Subtotal	19,413	46,281	64,340	78,047	94,148	109,664	117,147	129,440	145,603	161,652	180,982	199,653	201,898	206,326	209,817	214,757	219,957
Total Expenses	49,894	79,298	98,655	113,726	131,258	148,277	157,338	171,288	189,191	207,066	228,315	249,000	253,360	260,008	265,831	273,220	280,990
Less Other Revs. ***	9,169	5,317	5,583	5,862	6,155	6,463	6,786	7,125	7,482	7,856	8,248	8,661	9,094	9,549	10,026	10,527	11,054
Required from Rates	40,725	73,981	93,072	107,864	125,103	141,814	150,552	164,162	181,709	199,211	220,066	240,339	244,266	250,460	255,805	262,692	269,937
% Increases																	
Total %		81.66%	25.81%	15.89%	15.98%	13.36%	6.16%	9.04%	10.69%	9.63%	10.47%	9.21%	1.63%	2.54%	2.13%	2.69%	2.76%
Local %		15.68%	1.40%	1.16%	1.06%	0.96%	0.88%	0.88%	0.84%	0.80%	0.77%	0.73%	0.70%	0.72%	0.74%	0.76%	0.78%
MWRA %		65.97%	24.41%	14.73%	14.93%	12.40%	5.28%	8.16%	9.85%	8.83%	9.70%	8.48%	0.93%	1.81%	1.39%	1.93%	1.98%

Note: * Items increased annually for inflation by 5.0%

** reflects approximate annual debt service on outstanding bonds as of Sept. 1987 - Anticipated additional local bond issues not included.

*** Item increased for inflation - does not include prior year's surplus or federal grants after 1987.

TABLE 7.4.4-2
PROJECTED BWSC SEWER RATES AND FINANCIAL IMPACTS

	1987	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Rate Schedule (per 1000 cu ft)																	
1st 15 cuft/day	$10.100	$18.348	$23.082	$26.751	$31.026	$35.171	$37.338	$40.713	$45.065	$49.405	$54.578	$59.605	$60.579	$62.115	$63.441	$65.149	$66.946
next 20 cu ft/day	$10.210	$18.547	$23.334	$27.042	$31.364	$35.554	$37.744	$41.157	$45.556	$49.943	$55.172	$60.254	$61.239	$62.792	$64.132	$65.859	$67.675
next 50 cu ft/day	$10.320	$18.747	$23.585	$27.333	$31.702	$35.937	$38.151	$41.600	$46.046	$50.481	$55.766	$60.904	$61.899	$63.468	$64.823	$66.568	$68.404
next 70 cu ft/day	$10.430	$18.947	$23.836	$27.625	$32.040	$36.320	$38.558	$42.043	$46.537	$51.019	$56.361	$61.553	$62.559	$64.145	$65.514	$67.278	$69.133
next 190 cu ft/day	$10.540	$19.147	$24.088	$27.916	$32.378	$36.703	$38.964	$42.487	$47.028	$51.558	$56.955	$62.202	$63.218	$64.821	$66.205	$67.987	$69.862
next 250 cu ft/day	$10.650	$19.347	$24.339	$28.207	$32.716	$37.086	$39.371	$42.930	$47.519	$52.096	$57.550	$62.851	$63.878	$65.498	$66.896	$68.697	$70.591
next 700 cu ft/day	$10.760	$19.546	$24.591	$28.499	$33.054	$37.469	$39.778	$43.374	$48.010	$52.634	$58.144	$63.500	$64.538	$66.174	$67.587	$69.406	$71.320
next 1700 cu ft/day	$10.870	$19.746	$24.842	$28.790	$33.392	$37.852	$40.184	$43.817	$48.500	$53.172	$58.738	$64.149	$65.198	$66.851	$68.278	$70.116	$72.049
next 3000 cu ft/day	$10.980	$19.946	$25.093	$29.081	$33.729	$38.235	$40.591	$44.260	$48.991	$53.710	$59.333	$64.799	$65.857	$67.527	$68.969	$70.825	$72.778
over 5999 cu ft/day	$11.090	$20.146	$25.345	$29.373	$34.067	$38.618	$40.998	$44.704	$49.482	$54.248	$59.927	$65.448	$66.517	$68.204	$69.659	$71.535	$73.508
Annual Cost for Use of																	
10,000 cu ft/yr	$100	$181	$228	$264	$307	$348	$369	$403	$446	$488	$540	$589	$599	$614	$627	$644	$662
500,000 cu ft/yr	$6,523	$11,850	$14,908	$17,278	$20,039	$22,716	$24,115	$26,295	$29,106	$31,909	$35,250	$38,497	$35,126	$40,118	$40,975	$42,078	$43,238
5,000,000 cu ft/yr	$54,988	$99,890	$125,667	$145,640	$168,917	$191,480	$203,279	$221,656	$245,348	$268,978	$297,138	$324,510	$329,813	$338,176	$345,394	$354,693	$364,474
Breakdown of Annual Local/MWRA bill for 10,000 cu ft/yr. user																	
Local	$52.26	$67.92	$70.45	$73.11	$75.90	$78.83	$81.91	$85.14	$88.53	$92.09	$95.83	$99.76	$103.89	$108.22	$112.76	$117.54	$122.55
MWRA	$47.60	$113.48	$157.76	$191.37	$230.85	$268.89	$287.24	$317.38	$357.02	$396.37	$443.76	$489.54	$495.05	$505.91	$514.47	$526.58	$539.33

- A typical single-family residential customer using 10,000 ft^3 of water per year (205 gal/day).
- A medium-size commercial customer using 500,000 ft^3 of water per year (10,245 gal/day).
- A large-volume customer using 5 million ft^3 of water per year (over 100,000 gal/day).

Under the base case, the annual sewer bill (not including water) for a typical single-family residential customer in Boston will increase from the current $100 per year to approximately $660 per year by the year 2005. In evaluating this impact, it must be remembered that this sewer bill will be paid in inflated year 2005 dollars.

Table 7.4.4-3 presents a comparison of the typical single-family user's sewer bill under the base case (as presented in Table 7.4.4-2) with the projected bills under the alternatives. Figure 7.4.4-1 presents the projected financial impacts of the base case and alternatives graphically.

7.4.5 FINANCIAL IMPACT ON NEEDHAM

Needham has adopted a policy of wastewater expense recovery whereby the amount of the last MDC assessment prior to the creation of the MWRA ($297,575) plus all local wastewater-related expenses are recovered through the Town's property taxes. The local sewer user charge system is used to recover only the MWRA charges above the last MDC assessment amount. As MWRA charges grow, the amount recovered through the user charge system will increase.

Table 7.4.5-1 presents the projected wastewater expenses in Needham. These include projections of Needham's local operating cost plus projected MWRA charges.

Table 7.4.5-2 presents the estimated future wastewater costs (sewer bill plus property tax) for a typical residential user and a larger volume user in Needham. The breakdown between local costs and MWRA charges is also provided.

Table 7.4.5-3 presents a comparison of the base case financial impact on a typical single family user with the alternatives considered. Figure 7.4.5-1 presents the projected financial impacts of the base case and alternatives graphically.

7.5 CONCLUSIONS

The funding of construction projects for the Boston Harbor Clean-Up Program will have a significant impact on the sewer bills of users in the MWRA service area. The financial impact analyses present estimated future sewer bills based on the assumptions presented. While communities with two different cost recovery philosophies were selected to show the impact on users of various cost recovery philosophies, the values shown in these communities may not be applicable to other similar communities. The level of local operating and debt costs will vary in different communities as will the proportion of MWRA costs to total costs.

TABLE 7.4.4-3
COMPARISON OF 1 FAMILY BWSC RESIDENTIAL USER'S SEWER BILL
BASE CASE AND ALTERNATIVES

	1987	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Base Case	$100	$181	$228	$264	$307	$348	$369	$403	$446	$488	$540	$589	$599	$614	$627	$644	$662
Alternative 1	$100	$200	$269	$329	$400	$471	$523	$590	$674	$762	$864	$961	$993	$1,037	$1,082	$1,134	$1,191
Alternative 2	$100	$180	$226	$261	$303	$343	$363	$396	$438	$479	$530	$578	$587	$602	$614	$630	$647
Alternative 3	$100	$177	$220	$253	$291	$328	$345	$375	$414	$453	$500	$546	$554	$568	$579	$594	$611
Alternative 4	$100	$167	$199	$218	$241	$263	$267	$283	$307	$329	$360	$392	$394	$401	$406	$413	$421

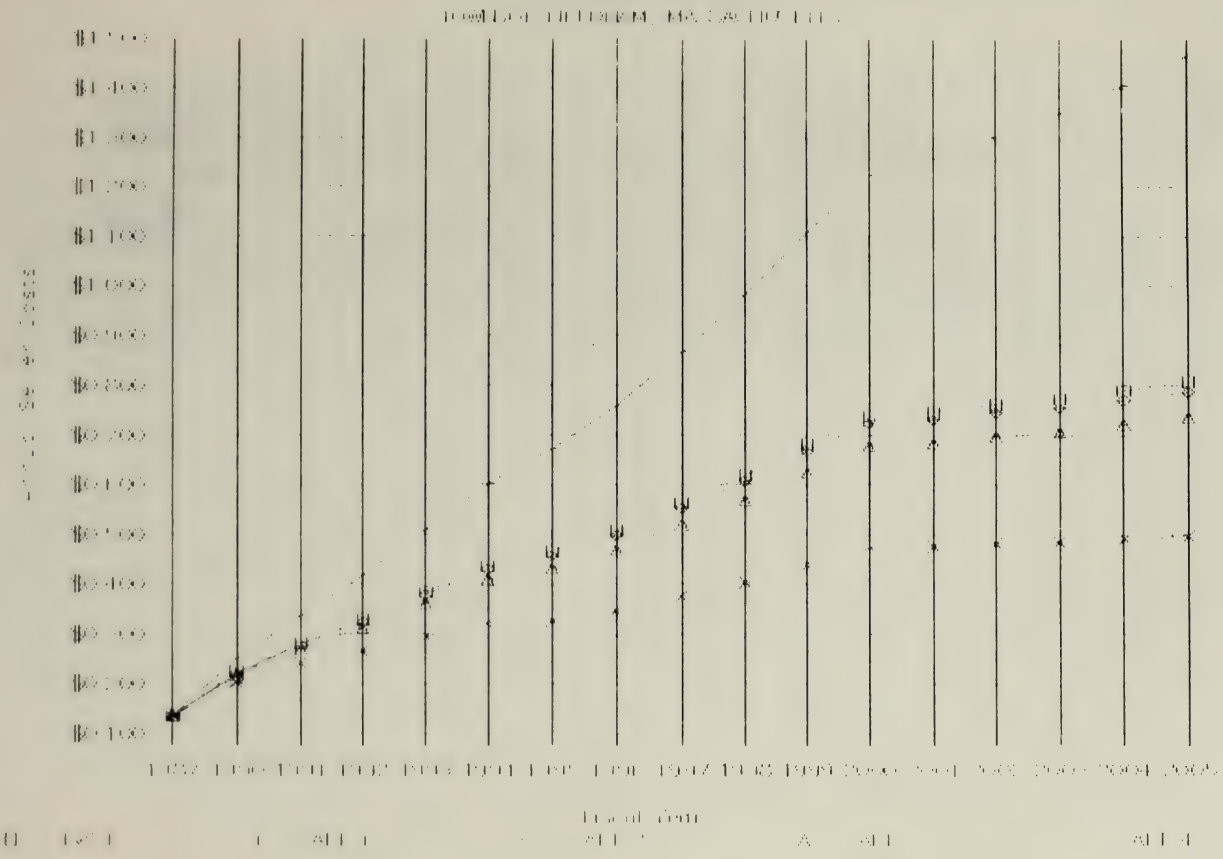


FIGURE 7.4.4-1

TABLE 7.4.5-1
PROJECTED EXPENSES - TOWN OF NEEDHAM
(VALUES IN $1000)

	1987	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
LOCAL EXPENSES ($1000)	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Direct Expenses	580	672	705	741	778	817	857	900	945	993	1,042	1,094	1,149	1,207	1,267	1,330	1,397
Indirect Expenses	181	209	220	231	242	254	267	280	294	309	324	341	358	376	394	414	435
Subtotal	761	881	925	971	1,020	1,071	1,124	1,181	1,240	1,302	1,367	1,435	1,507	1,582	1,661	1,744	1,831
MWRA ASSESSMENTS																	
MWRA Operating	----	1,146	1,470	1,485	1,554	1,638	1,482	1,490	1,577	1,638	1,966	2,545	2,586	2,715	2,851	2,993	3,143
MWRA Capital	----	712	1,132	1,720	2,351	2,939	3,450	3,983	4,595	5,233	5,705	5,856	5,909	5,954	5,950	6,003	6,059
Subtotal	760	1,858	2,603	3,205	3,905	4,576	4,932	5,473	6,172	6,871	7,671	8,402	8,494	8,669	8,801	8,996	9,202
Total Expenses	1,521	2,739	3,528	4,177	4,925	5,647	6,056	6,654	7,412	8,173	9,038	9,837	10,001	10,251	10,462	10,740	11,033
"Rate" Expenses	463	1,560	2,305	2,908	3,607	4,279	4,634	5,175	5,875	6,573	7,374	8,104	8,197	8,371	8,504	8,699	8,904
"Tax" Expenses	1,059	1,179	1,223	1,269	1,317	1,368	1,422	1,478	1,537	1,599	1,664	1,733	1,804	1,880	1,959	2,042	2,129

TABLE 7.4.5-2
PROJECTED NEEDHAM SEWER & TAX RATES PLUS FINANCIAL IMPACTS

	1987	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
ANNUAL SEWER USE CHARGE																	
Rate per 100 c.f.	$0.36	$1.20	$1.77	$2.24	$2.77	$3.29	$3.56	$3.98	$4.52	$5.06	$5.67	$6.23	$6.31	$6.44	$6.54	$6.69	$6.85
10,000 cu ft/year	$36	$120	$177	$224	$277	$329	$356	$398	$452	$506	$567	$623	$631	$644	$654	$669	$685
30,000 cu ft/year	$107	$360	$532	$671	$832	$987	$1,069	$1,194	$1,356	$1,517	$1,702	$1,870	$1,892	$1,932	$1,962	$2,007	$2,055
SEWER TAX RATE:																	
Total Valuation ($1000)	3100000	3905107	4217516	4554917	4919310	5312855	5737884	6196914	6692667	7228081	7806327	8430834	9105300	9833724	10620422	11470056	12387660
Sewer Tax per $1000	$0.34	$0.30	$0.29	$0.28	$0.27	$0.26	$0.25	$0.24	$0.23	$0.22	$0.21	$0.21	$0.20	$0.19	$0.18	$0.18	$0.17
Valuation-Avg. House	298	344	362	380	399	419	440	462	485	509	534	561	589	619	650	682	716
Annual Sewer Tax assessment for the average home	$101.61	$103.96	$104.85	$105.79	$106.79	$107.84	$108.95	$110.11	$111.33	$112.60	$113.93	$115.31	$116.75	$118.25	$119.80	$121.41	$123.08
Valuation-Large User	375	434	456	479	503	528	554	582	611	641	673	707	742	780	819	860	902
Annual Sewer Tax assessment for the average home	$128.05	$131.01	$132.13	$133.32	$134.58	$135.90	$137.30	$138.76	$140.29	$141.90	$143.57	$145.31	$147.13	$149.01	$150.97	$153.00	$155.10
Total Annual Sewer Charges - Average Single Family Home																	
User Charge	$36	$120	$177	$224	$277	$329	$356	$398	$452	$506	$567	$623	$631	$644	$654	$669	$685
Property Tax	$102	$104	$105	$106	$107	$108	$109	$110	$111	$113	$114	$115	$117	$118	$120	$121	$123
Total	$137	$224	$282	$329	$384	$437	$465	$508	$563	$618	$681	$739	$747	$762	$774	$791	$808
Breakdown of Local/MWRA cost for Average Single Family Home																	
Local	$73	$78	$79	$81	$83	$84	$86	$88	$90	$92	$94	$96	$97	$100	$102	$104	$106
MWRA	$64	$146	$203	$248	$302	$353	$379	$420	$473	$527	$588	$643	$650	$663	$672	$687	$702
Total Sewer Charges - Large Volume User																	
User Charge	$107	$360	$532	$671	$832	$987	$1,069	$1,194	$1,356	$1,517	$1,702	$1,870	$1,892	$1,932	$1,962	$2,007	$2,055
Property Tax	$128	$131	$132	$133	$135	$136	$137	$139	$140	$142	$144	$145	$147	$149	$151	$153	$155
Total	$235	$491	$664	$804	$967	$1,123	$1,207	$1,333	$1,496	$1,659	$1,845	$2,016	$2,039	$2,081	$2,113	$2,160	$2,210

TABLE 7.4.5-3
COMPARISON OF 1 FAMILY WRENTHAM RESIDENTIAL USER'S SEWER CHARGES
BASE CASE AND ALTERNATIVES

	1987	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Base Case	$137	$224	$282	$329	$384	$437	$465	$508	$563	$618	$681	$739	$747	$762	$774	$791	$808
Alternative 1	$137	$251	$338	$417	$510	$603	$672	$759	$867	$981	$1,108	$1,222	$1,257	$1,303	$1,350	$1,405	$1,465
Alternative 2	$137	$223	$279	$325	$379	$430	$457	$499	$552	$606	$667	$724	$731	$745	$756	$771	$787
Alternative 3	$137	$219	$271	$313	$362	$410	$433	$470	$519	$569	$626	$678	$685	$698	$707	$722	$737
Alternative 4	$137	$204	$242	$266	$295	$322	$327	$347	$376	$404	$440	$476	$476	$482	$484	$491	$498

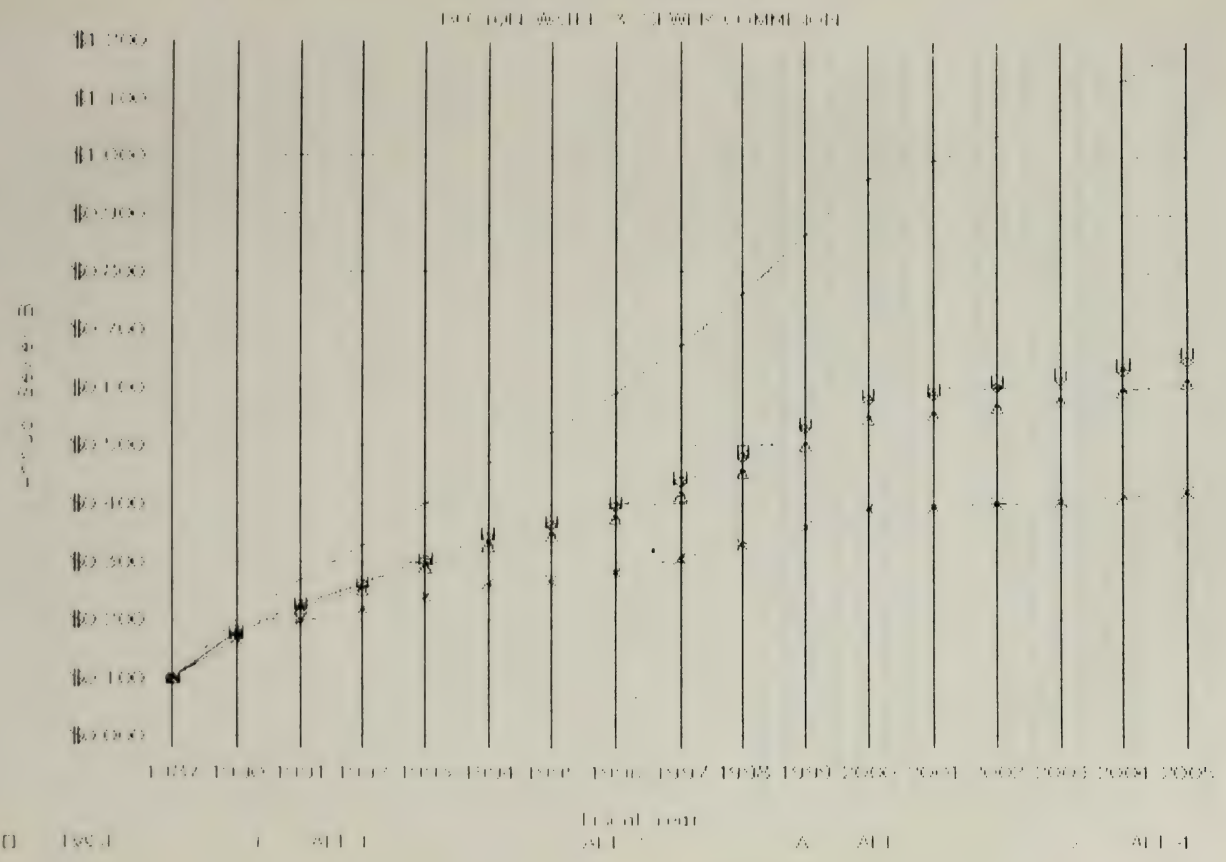


FIGURE 7.4.5-1

It also must be noted that many communities have combined water and sewer bills. This analysis has only presented the impact on the sewer portion of combined bills.

All costs and financial impacts have been presented in terms of inflated dollars to account for expected increases in construction and operating costs in future years. Accordingly, all projected sewer charges and retail bills would be paid in future dollars as well. To determine the impact in current-day dollars, an analysis was made assuming no inflation. Total construction costs would be as presented in Table 7.2-1. Annual (sewer only) bills would increase to approximately $400 per year for a single family user in FY 2005 in Boston and Needham under the base case assumptions with no inflation.

While construction and operation of new facilities to clean up Boston Harbor will be a significant factor in the projected increases in MWRA charges and retail sewer bills, it must be acknowledged that these charges would increase otherwise due to inflationary impacts. To determine the impact of the Boston Harbor Clean-Up Program, an analysis of projected charges and retail sewer bills was made assuming (1) no new construction other than the projected administrative, interceptor and pumping station projects and (2) no new operating costs associated with new facilities. Without the required construction projects and associated operating costs, retail sewer bills in Boston and Needham would still increase to approximately $200 for a single-family user under the base case assumptions.

Section 8

8.0 HUMAN RESOURCES

8.1 OPERATION AND MAINTENANCE ORGANIZATION

The MWRA wastewater treatment facilities will include the Deer Island Wastewater Treatment Plant; the three existing North System headworks, and the new Nut Island Headworks.

The new treatment facilities will require a significant expansion in the number of staff, the degree of staff skills, and the systems used to operate and maintain these facilities. To provide a realistic assessment of the required numbers of staff and their skills, a prototype operational concept is described in the following sections. This organizational concept, while prototype only, will identify many of the issues that MWRA will have to manage in order to build its operational capability concurrently with the building of the new facilities. It is strongly recommended that MWRA develop its final operational concept at the earliest possible date. As discussed below, the final operational concept is an essential piece of information for facilities design, construction and start-up and is required at an early date to provide the lead time needed to prepare for full operational start-up of the primary (1993-1995) and secondary (1999) facilities.

The present treatment and headworks facilities have operated autonomously from one another, but under the same departmental umbrella, for some time. Operations and maintenance staff have been assigned to each facility while the laboratory and administrative functions have been carried out at Deer Island. Staffing levels at Nut Island and the remote headworks have been somewhat easier to maintain than at the Deer Island facilities. This has resulted in many changes to the Deer Island plant's organizational structure in an attempt to find a way to attract additional employees to the facility. The amount of overtime required at Deer Island has been high because of many position vacancies. An effort has been made recently to upgrade salaries and benefits and to resolve recruitment problems of this type with an eye toward future staffing needs of the new facilities. It is also believed that the difficult commute to the Deer Island site has been detrimental to attracting personnel and may limit the area around the site in which recruiting can be effectively accomplished.

The objectives of the organizational concept include:

- o Provide effective management and supervision of a large staff.
- o Guide the staff towards achievement of the Authority's objective of effective pollution control.
- o Direct staff to maintain high productivity.
- o Provide an efficient structure for information flow.

- o Provide support functions to operating staff.
- o Minimize operations and maintenance costs while attaining performance objectives.
- o Establish accountability through all staffing levels.
- o Provide career ladder for employees.

The prototype system, or one of a similar structure, is used at most of the large wastewater treatment facilities throughout this country. It is easy to expand or to change as the needs of the facilities complex change over the years. Another strength of the prototype organization is that the structure allows for the effective placement of all personnel as the phased construction is completed and the existing facilities are modified or dismantled. The new primary facilities are scheduled to be fully on line in 1995. The personnel assigned to operate and maintain these facilities will, through experience and training, become the "core group of employees" that will eventually operate and maintain the secondary facilities that will be operational by late 1999.

In addition to the organizational structure discussed herein, the MWRA should carefully evaluate the use of private contractors to operate certain key areas of the recommended facilities. The power and oxygen generation systems are prime facilities that should be considered for private operation in order to obtain the most efficient, reliable operation of these facilities. As discussed under the evaluation of the oxygen facilities, as a minimum, the yearly turnaround of the cryogenic facilities should be considered for outside contract. The overall maintenance program should be carefully evaluated to determine if certain other maintenance tasks could be best performed by highly qualified, specialist contractors or equipment vendors.

8.1.1 PROTOTYPE ORGANIZATIONAL STRUCTURE

The MWRA Wastewater Treatment prototype organization discussed in this section fits within the Authority's organizational structure as follows: The Authority is divided into two Divisions (Water and Sewer); the Sewer Division is divided into a number of Departments including Operations, Water Quality and Maintenance Engineering. The Deer Island Wastewater Treatment Facilities fall under the jurisdiction of the Operations Department. The prototype organization is then structured into sections which are further divided into process units or teams as applicable.

The prototype structure based on the section approach has the goal of meeting the organizational objectives by providing (1) simplicity of structure; (2) minimization of the number of position titles; (3) broad-based position descriptions; (4) a team concept throughout the organization; and (5) a structure that provides a career ladder for employees. The prototype organization will be structured into four sections:

1. Operations
2. Maintenance
3. Administration
4. Laboratory

The team concept within the organization breaks down the staff into smaller, more manageable numbers with three major groups made up of management, supervisory and staff personnel dispersed throughout the four sections. The team concept is illustrated in Figure 8.1.1-1. The generic position titles are listed under the appropriate team and complex section. The numbers in parentheses following the titles within the section indicate the number of teams (if more than one) assigned to those particular functions or units.

Tables of organization that describe, in general terms, the functional responsibilities that will need to be accomplished by each section and the units within the sections are included in Appendix G. Also included are recommended organizational charts for the entire organization by section and units within the sections. Job titles are indicative of the functions that need to be accomplished in the new section structure and are not intended to match existing job titles or position descriptions.

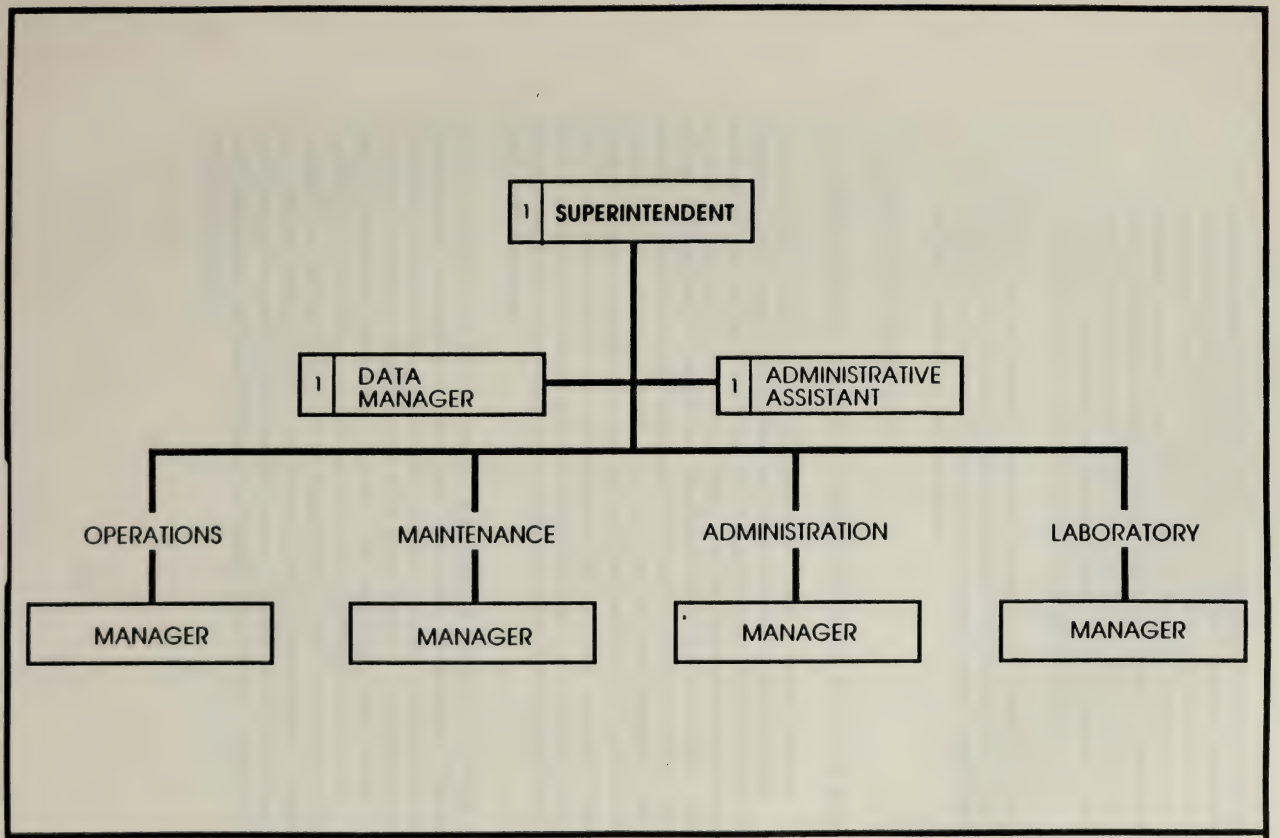
The prototype organizational structure is also broken into four distinct sections, each requiring different skills for the assigned personnel. These sections are: (1) Operations, (2) Maintenance, (3) Laboratory, and (4) Administration. The personnel requirements of each section in the year 1995 when the primary, disinfection, power generation and some of the residuals process units are online; and in 1999, when the total facility will be operating, are as follows:

Section	Personnel Required	
	1995	1999
Operations	172	209
Maintenance	205	275
Laboratory	12	16
Administration	30	40
Total Personnel	419	540

8.1.2 SEWERAGE DIVISION COORDINATION

Some of the functional units within the Deer Island treatment facilities, though autonomous in functional structure, must work with units and under management systems established by and controlled from the Sewerage Division's Central Office. Examples are:

1. Various functions in the Personnel Department such as timekeeping, benefits, labor relations, purchasing, budgets, etc.



MASSACHUSETTS WATER RESOURCES AUTHORITY

FIGURE 8.1.1-1
DEER ISLAND WASTEWATER TREATMENT COMPLEX
ORGANIZATIONAL CHART - MANAGEMENT TEAM

2. The laboratory at Deer Island, which is designed as a process control, permit requirement and troubleshooting unit to provide timely results for maximizing plant performance. The process control test results will include all sampling and analysis performed to control the facility's various unit processes. The permit requirement testing will include all analysis required for meeting conditions of the effluent discharge permit including metals analysis and toxicity tests. Laboratory personnel will work on occasion with the Sewerage Division's Central Laboratory, exchanging data on plant results and the Division's industrial pretreatment program.

3. The Maintenance Section Replacement Engineering Unit, which will be the Deer Island arm of the Sewerage Division's Maintenance Engineering Department staff, working under the direction of the Maintenance Manager but providing requested information to the Division's Maintenance Engineering office.

8.1.3 FUNCTIONAL DESCRIPTION

The prototype organization, as structured, is intended to function in the following manner:

The superintendent will provide the overall policies and direction that the Treatment facilities staff will follow. The Superintendent will be supported in establishing and implementing these policies and directions by a management team consisting of four section managers heading the four sections listed above. The Superintendent will also be supported by two staff personnel who will provide data (information) and administrative support. Additional administrative, financial and personnel support will come from the Administration section as required. All other duties will be delegated to one of the four section managers. This organization places the details of everyday activities at the section level. This allows the Superintendent to look at the broad picture and work with the section managers in setting up effective management systems that will implement changes and resolve problems in a timely manner. The Superintendent also provides the link to the other departments within the Sewerage Division of the Authority.

The four section managers are supported by a second level of management, known as the supervisory team, who will be the leaders of the various units within a section. This team includes all the assistant managers, directors, supervisors, foremen, and other personnel assigned to a section and reporting directly to the section manager. This breakdown in the chain of command and position titles is apparent in the Organization Charts included in Appendix G. In establishing the functional units within a section, the major criteria considered were the span of control of the managers and the various supervisory members of the team. The four sections are broken into functional units or groups and each is assigned certain areas of responsibility within the total structure. These areas are small enough to provide management with control of the unit and establish accountability of performance of the staff personnel assigned.

8.1.4 POSITION IDENTIFICATION, PLACEMENT AND TRAINING

Position Descriptions

After establishing the (1) Functional Table of Organization (section responsibilities); and (2) Organizational Charts (titles and numbers of employees required to accomplish the tasks) as illustrated in Appendix G; the third part of the structure, the Position Descriptions, must be established. Position descriptions identify an employee's duties and responsibilities, and the qualifications to successfully fulfill a particular employee's position. These descriptions must have a formal and consistent format and one position description should be prepared for each position shown on the organizational chart. The position descriptions should include:

1. General Statement of Duties
2. Supervision Received
3. Supervision Exercised
4. Examples of Duties
5. Special Duties
6. Entrance Requirements and Qualifications
7. Special Working Conditions
8. Salary Classification

A few sample position descriptions are also included in Appendix G.

The position descriptions, when prepared, will detail the skills needed by employees being placed in the prototype organizational structure. A sample of some of those position skills follows:

Position	Basic Skill Requirements
Operators	5 years' wastewater experience, Class III certification. Mathematical and mechanical aptitudes.
Attendants	Mathematical and mechanical aptitudes.
Unit Foreman	6 years' wastewater experience, Class V certification (minimum), 4 years' supervisory experience.
Shift Supervisor	8 years' wastewater experience, Class VI certification, 3 years' "responsible charge" supervisory experience.
Assistant Managers	12 years' experience, Class VII certification, 6 years' "responsible charge" management experience.

Operations Manager	15 years' experience, Class VII certification, 10 years' "responsible charge" management experience, degree in engineering or related science.
Maintenance Manager	15 years' experience in maintenance and repair, 6 years' experience as working supervisor, degree desirable.
Chief Scheduler	10 years' experience in scheduling maintenance work, 5 years in supervision, experience with computerized maintenance management systems.
Maintenance Foreman	6 years' hands-on maintenance experience, 4 years' supervisory experience, 2 years' computerized maintenance experience.
Mechanics, Welders, Machinists	Should have qualifications of a journeyman in the craft area of responsibility. Completion of apprenticeship programs is highly desirable and required for some positions. 5 years' actual experience is required.

Other position descriptions are somewhat self-explanatory, but actual qualifications must be written into the descriptions during their preparation after the Authority adopts a final organizational structure. From the brief overview presented above, it is apparent that a wide range of skills, experience, education, and in the Operations Section, certification as a Commonwealth of Massachusetts Wastewater Operator, will be required in the overall organizational structure from the Superintendent to the laborers' levels.

Staff Size and Skill Requirements

The Deer Island facilities' prototype organization will require a large complement of personnel. The four sections will be large staffs within the organization requiring strong leadership by the Assistant Managers. The following discusses the size of the staff, the basic skills required and the importance of an effective recruitment and retention strategy as discussed in Section 11.5.2 (Training and Staff Development).

The organization is divided into five employee groups corresponding to the four sections described earlier in this section. The staff will number about 540 people, who will be assigned as follows:

Employee Group	Personnel Required	
	1995	1999
Superintendent's Office	3	3
Operations	169	206

Maintenance	205	275
Laboratory	12	16
Administration	30	40
Total	419	540

The present staff of about 260 (Deer Island, Nut Island and 3 Headworks) should be reviewed, evaluated, and skill-tested for placement in the new prototype organization. The additional people required to bring the staff up to the required 1995 and 1999 levels will be recruited and placed as the new facilities are constructed and approach the start-up phase of the project. The Superintendent's Office, Maintenance, Laboratory and Administration personnel will be assigned to steady day shifts. The Operations personnel will work shifts covering the facilities 7 days per week/24 hours per day/365 days per year. The Operations staff will be scheduled to minimize coverage on the off-day turn shifts and weekends. It is estimated that the afternoon and midnight shifts and the weekends will be covered by approximately 19 operations personnel at all times. The quality of working conditions could be improved with innovative scheduling, such as 4-day weeks or 12-hour schedules. This approach could also reduce the employee's cost and frequency of commuting to Deer Island. It is recommended that an organization of concept be adopted, that many of the systems be put in place, and that personnel placement be completed before the end of 1991, along with the scheduling and salary planning needed to prepare for the construction period and the new facilities start-up.

Staff Placement

The proper placement of staff in the required positions at the proper time is also a critical issue in staffing the organization of the Deer Island treatment facility. The phased construction program places a heavy demand on the management staff for existing personnel to be in place and properly trained in a continuing effort to meet the required effluent limits during this period. This process must start immediately so that the existing staff can be placed and trained to handle the ongoing process requirements while new staff are being hired, trained and placed, before the new primary disinfection and residual facilities are brought online. It is expected that a minimum of 150 existing personnel and 150 new people will be trained before the end of 1995. The remaining 130 personnel must be hired and trained before mid-1999. This is a tremendous task to be accomplished within the scheduled time frame.

8.1.5 TREATMENT PLANT CONTROL STRATEGY

The large numbers of staff, and the variety of their skill requirements, that are necessary at Deer Island require that considerable thought be given to how the facilities are going to be effectively controlled when operational. The control process depends on two distinctly different systems (i.e., a personnel system and an operations system) that integrate the work of the four sections to accomplish the mission of effective pollution control.

Control of Personnel

The control of personnel to effectively blend numerous skills and personalities starts with an

understanding on the part of each individual of what his position assignment is intended to accomplish in the total structure of the organization. The direction of the staff centers on the management team which is indicated on Figure 8.1.1-1. It is intended in the prototype organization that the Superintendent will not get involved in every detail of operation, but will delegate responsibility to the four section managers. The Superintendent receives information required for review of results, for decision-making and for directing the section managers from the Data Manager and the four section managers. By utilizing this approach, the Superintendent can view the overall picture of accomplishments, needs and direction of the organization and provide guidance to the section managers to resolve or address problems related to their assigned section that impact the overall achievements of the plant. The four section managers manage their respective organizations in the same manner by utilizing and directing the supervisors, assistant managers and foremen assigned to them. The prototype organization was structured to ensure that no assistant manager's span of control will be greater than 6 supervisory personnel. This provides effective management and supervisory input to the operation of the sections. Each of the four sections was provided a position within the section to furnish to the supervisory staff the information needed to make the decisions required by their position in the organization. Clerical assistance to all sections will be provided by the Clerical Unit within the Administration Section and controlled by the Principal Clerk.

The Assistant Managers provide the direction of the sections through the supervisory teams identified in Figure 8.1.1-1. In turn, the supervisory personnel control the detailed tasks of the assigned staff teams in each of the sections. Again, the span of control was restricted for each supervisory position to a specified number of personnel and equipment area responsibilities to ensure successful achievement of the assigned responsibilities.

Control of Operations Systems

Each of the four sections encompasses tasks that are both interrelated to each other and unique to their section. An example is that the primary focus of successful fulfillment of the Authority's mission is on the Operations Section; however, the other three sections must perform their roles successfully for the Operations Section to achieve its goals. The other three sections must be viewed as support services for the Operations Section. This direction will be accomplished by the development of detailed management systems as discussed in Section 11.5.2 of Volume III. As an example, the process control management system (PCS) details how the treatment process will be controlled, by whom it will be controlled, and what input is required from others (such as laboratory results of process sampling and analysis). These systems become critical in a large complex system staffed with numerous people and sprawled over a large area. They also provide accountability for individual unit process performance and the personnel assigned to that process area. This management system, in conjunction with the MIS, the sampling and analysis plan (SAP), and the maintenance management system (MMS) defines the needed flow of information, the proper sampling and analysis information and equipment reliability to properly achieve the required results. These systems and the utilization of an interactive and networked computer system will assist in holding the various operating functions together. The Operations Section is also divided into five manageable

units (Headworks, Pump & Power, Primary Treatment, Secondary Treatment and Residuals). The organizational chart for the Operations Section is also structured to correspond to these process units (see Appendix G). The physical control of the Operations Section focuses on operation control centers connected by a distributive digital control and central information system. The process will be controlled by the process control personnel located in the operations management center in the Administration Building. Information on operations, security, maintenance and laboratory will go to the operations management center before distribution to the four main control centers located in the Primary, Secondary, Pumping and Power, and Residuals areas of the facilities. Overall plant operating decisions will be made at the operations management level with implementation being carried out from the four main control centers.

The Data Manager in the Superintendent's Office, in addition to providing information to the management team, coordinates the flow of information throughout the computerized management information system (MIS). "Needs to know" information will be identified for use by each manager and supervisor as needed to properly perform their duties; and through the computer system, this data will be provided to the proper location for effective control of an assigned area. The Data Manager is supported throughout the organization by a number of clerks (Administrative Data Entry, Laboratory Data Technician, Maintenance Stores Clerk, Scheduling Clerks and Operations Process Technicians) who input the identified and required information into the system for use. All status reports, executive summary reports and required regulatory reports will be computer-generated from the MIS.

The maintenance control strategy will focus on the computerized MIS and will address all maintenance requirements including preventive and corrective maintenance. The computerized MIS will provide a list of all equipment in the system, an equipment numbering system, detailed equipment information, the preventive maintenance (PM) program, the lubrication program, a work order system to assign and track work completion, an equipment maintenance record system, a storeroom inventory system for parts, tools and supplies, supported by a purchasing system to replenish inventory depleted. Requests for corrective maintenance will be written by any employee, submitted to a supervisor for verification and clarification and submitted to the Scheduling/Planning Group in the Maintenance Section for input into the system. This group will schedule the work, the personnel needs, parts, supplies, or tools needed, print a computerized work order form detailing the information required, and give the forms to the appropriate assistant maintenance manager for review and assignment to a foreman in charge of the maintenance team that will do the work. The form will be returned by the same route back to the Scheduling/Planning Group for completion notice to operations, input to the record system and removed from the routing.

This maintenance system and all of the maintenance personnel, shops and main storeroom will be located in the Maintenance Control Center Building.

The Administration Section will be located in the Administration Building and provide support to all sections including clerical, personnel, first aid, financial, safety, fire protection and transportation, and security teams. Requests for administrative services must be approved

by supervisory and assistant management personnel to minimize unnecessary requests of these groups.

Two special groups have also been organized within the structure of the Administration Section. They are: (1) Transportation and Security, and (2) Safety and Fire Protection.

The transportation issues arising from the movement of many people each day to Deer Island for work and deliveries of supplies, materials, and chemicals will require considerable coordination. As a result of restricted traffic flow through Winthrop, most of the traffic will come through the Deer Island dock area by barge. The security of the facility will also be controlled from the two entrance points (Winthrop and the dock). Security forces may be provided by MWRA staff or by an outside private contractor 24 hours per day/7 days per week. Both the transportation and security functions will be coordinated and directed by the Transportation and Security Unit within the Administration Section.

The Safety and Fire Protection Unit, also established within the Administration Section, will coordinate and direct these activities. It is intended that the safety personnel will define, outline, and be responsible for the implementation of the Deer Island safety program through coordination with outside vendors and the Deer Island Training Unit.

A Fire Chief position has been recommended which will organize a volunteer fire unit in the Deer Island Plant, including personnel and equipment. This unit will be trained in firefighting and the handling of major chemical spills. The position will also establish and coordinate cooperative agreeements with the Town of Winthrop and the City of Boston to assist in major incidents that might occur.

The Laboratory Section is also a support section for the operation of the facilities. They will coordinate and schedule all sampling and perform analysis for process control and permit requirements. The laboratory will be located in the Operations Management Building.

8.2 TRAINING AND STAFF DEVELOPMENT

8.2.1 INTRODUCTION

The best-planned, designed and constructed wastewater facilities will not perform properly unless staffed with qualified, adequately compensated, dedicated and appropriately trained personnel. These standards must be addressed through an effective personnel recruitment and retention strategy. An effective recruitment program must address the issues necessary to attract well qualified and trainable personnel. Some of the issues that are important in recruitment of personnel for the Deer Island treatment facility include:

- o Identification of the qualifications that address the skill requirements of all the positions in the organization chart;
- o Pay scales and benefit packages that will attract qualified and skilled applicants;

- o Identification and resolution of alternatives that address the problem of commuting to the Deer Island site;

- o Identification and publicizing of the opportunities for advancement within the organization;

- o Developing an awareness of interesting work and career opportunities at the Deer Island plant;

- o Providing entry-level training and certification opportunities for newly recruited personnel; and

- o Identification and preparation of a procurement strategy that will address the four hundred new hires required to staff the Deer Island facilities in the year 1999.

The intricacies of the new Deer Island Wastewater Treatment Plant, including the four remote headworks, are coupled with some additional problems unique to these facilities such as: the Boston Harbor location, commuting problems, competition for skilled labor, and the area's economic considerations including the high cost of living. Such factors compound the issues of staff procurement and development. These questions and the need to address their solutions require an organized approach that will culminate in the staff being prepared to manage, operate and maintain the facilities that are existing and those that will be placed in operation in 1993-1995 (primary treatment) as well as, ultimately, the secondary facilities in 1999. A well-thought-out recruiting plan, in conjunction with competitive compensation and attention to the provision of special transportation and scheduling accommodations for hired workers, should alleviate the unusual stresses mentioned above and aid in the attainment of this goal.

These issues must be addressed and resolved so that operations and maintenance staff will be in place for the start-up of primary treatment facilities in 1995 and for the start-up of the secondary facilities in 1999. A suggested procedure includes:

1. Adoption of an organizational structure for management/operation of the new facilities.

2. Preparation of complete position descriptions, including duties and qualifications, for each position in the organizational structure.

3. Adoption of competitive salary schedules and benefit packages per position and grade.

4. Determination of staffing needs for start-up and operation of the phased facilities.

5. Development of programs to train the staff to operate the new facilities.

6. Procurement and placement of staff. (This includes a review of qualifications and placement of the existing staff into the new organizational structure, and the hiring of new personnel.)

7. Training of personnel, phased as required to meet the needs of the new facilities.

8. Establishment of special or innovative provisions in the areas of transportation, shift scheduling, unusual circumstances related to employment at the facility.

8.2.2 TRAINING

Recruitment and Placement

The prototype organization, as discussed in Section 11.5.1 of Volume III, is demonstrated through the use of functional tables of organization and organizational charts included in Appendix G. It is recommended that an organizational structure be adopted by the Authority so that the position descriptions can be prepared, the salary structure prepared and adopted, and the screening and placement of existing personnel begin.

The actual recruitment procedure must begin after the organizational structure, position descriptions and salary and benefits are prepared and adopted by the Authority. This procedure must focus on obtaining local people and training them to fulfill the new job requirements. Recruitment of personnel with existing wastewater skills will be very limited because of the lack of such people within commuting distance of the facilities. Some personnel from outside the Boston recruiting area who have skills and experience in the wastewater treatment field should be hired for the management/supervisory positions. The general direction of the recruitment effort will be to place some experienced personnel in management/supervisory positions, and to advertise heavily in the trade journals, periodicals and local newspapers to attract interested applicants. The advertisements should emphasize the skills required for each position. The Authority's Personnel Department should determine staffing needs (numbers of people, skills, etc.) before the advertising part of the program begins. When the applications are received, an initial screening by the Personnel Department staff should be performed. This screening should focus on the (1) application received; (2) resume, if applicable; (3) work history; (4) work references; and (5) apparent reliability in work history. Based on the initial screening, the application should be matched to a skill level in one of the four sections in the organization, or rejected.

If the applicant can be matched, an interview should be conducted by a minimum of three Authority personnel (1 member of the Personnel Department, 1 from plant management, and 1 supervisor in the applicant's skill area). The interview should review and seek more detail in the applicant's interest in working at Deer Island, interest and willingness to be trained and to attend training sessions, and additional detailed information regarding skills, work history and references, if any.

It is recommended that all new applicants be tested, if possible, by the State Employment Service or by an outside contractor for aptitude and ability in reading, as well as the ability to perform basic mathematics and mechanical aptitude. Some positions in the organization require that applicants should be tested for their ability to write clearly.

The applicants are then ready for placement in a position compatible with their skills, based on the information gathered during the screening, interview and testing process. The decision on whether and where to place should be made in a meeting of the three interviewers. When the decision is made, the applicant should be informed of the decision in writing, detailing starting salary, benefits, report date, orientation procedure and initial training assignment.

The orientation of all employees should be thorough and should be required before the employee starts specific position training. The orientation should include: (1) the mission of the organization; (2) policies, procedures, and benefits; (3) where the assignment fits into the organization; (4) importance of the assignment; (5) importance of the training program; and (6) where to go with immediate questions that may come up during the orientation period.

The last step of the recruitment procedure is the assignment of employees to the training program specific to their position placement. It is recommended that the training program and salary structure be configured to encourage personnel to become more skilled in their position assignments through a combination of specific training programs, including off-site offerings, apprentice programs, management programs, and the passing of certification tests and other skill examinations that show competence in their assigned work areas. This program should be structured with built-in salary increases that are based on the successful completion of the specific training. This approach bases the employees' advancement on the initiative to become more qualified in the wastewater treatment field, and on the improvement of their job skills.

Certification Requirements

The end result of good training and a good job attitude on the part of the employees assigned to the Operations Section should be to become a certified wastewater treatment plant operator in the Commonwealth of Massachusetts. The state requires that the person in charge of the Operations Section, the assistant managers, and the shift supervisors in charge of the off-shifts be certified as Class VII Operators, which is the highest classification. Many of the other positions, such as unit foreman, should be required by the Authority to obtain certification at a lower level as a condition of holding those positions. Other levels down to Class I certification should be placed on the merit system of training and certification required to achieve salary increases.

Ultimately, when the secondary treatment facilities go online in 1999, there will be approximately 207 people in the Operations Section responsible for operating the facilities. State requirements for certification as of this time require 11 Class VII personnel (the operations manager, the five assistant managers, and the five shift supervisors). These are the only required certified personnel; but as recommended, the certification levels should be

built into the training and salary program to ensure advancement and the presence of trained, qualified Operations personnel at all levels.

The general approach to building the organization will be to use existing staff that meet position qualifications to develop a "core group" of qualified personnel who will provide a nucleus around which the complete organization can be built. The addition of the new personnel and preparation of amplified management systems described later in this section will expand the staff and its capabilities as the new facilities grow and treatment requirements increase.

Analysis of the Training Process

Training is the most important tool available to the Authority to protect its capital investment and provide optimum operational efficiency. A successful training program in a wastewater organization encompasses many facets of employee development that are essential for maintaining a skilled and responsible staff. While training must provide both general and specific training in the wastewater system's equipment and control, an attempt must be made throughout the program to build a general interest in the wastewater profession and a desire to "make it work". The training program must stress the interrelationships among jobs, departments and processes at the facilities, and the impact of a job well done (or poorly done) on the health and welfare of the community and the surrounding environment.

The instructors must be knowledgeable and experienced and make every attempt to provide a relaxed training atmosphere, where questions can be asked and problems and situations discussed freely. Feedback from the trainees is an effective measure of the progress and efficiency of the training and allows clarification and emphasis to be placed on critical points.

Based on current training available in the Boston area, the complexity and size of the new facilities, the non-availability of like facilities in the Boston area for a supply of experienced personnel and other problems unique to Deer Island, the Authority will be severely limited in obtaining people for the provision of effective training to the existing and newly-hired staff. The numbers of total personnel in the prototype organization of approximately 550 people, of which over 300 will be new hires, will create a demand on the local labor market if the present low unemployment rate remains stable. This will probably result in a young staff either just out of high school or technical school, or with less than a college degree and no experience in wastewater treatment. This will also be true of older potential employees and will result in the need for an extensive training program that must be organized and presented by the Authority. The program, again as a result of the type and numbers of people involved, must be extensive, site-specific, thorough and job-related in order to be effective and meet the needs of the Authority. Based on this analysis, an on-site training program should be set up and tailored specifically to the Authority's requirements.

Training Needs and Program

The training of personnel must be prepared and presented relative to three major considerations:

1. The section of assignment (i.e., operations, maintenance, administration or laboratory);
2. The unit of assignment within employee's section (i.e., management, supervisory or staff); and
3. The experience level of the employee.

The treatment plant is organized into four sections: Administration, Operations, Maintenance, and Laboratory, as previously discussed. Each of these sections has a specific role to achieve in the effective operation of the plant, but all are interrelated and each is dependent on the other. In general, the sections of administration, laboratory and maintenance are service sections that support the operations section. Training must tie these sections together functionally by providing precise understanding of the function of a particular section and also providing an understanding of the purposes of the other sections. To accomplish this, the training effort should be divided into six distinct areas:

1. Management
2. Supervisory
3. Operations
4. Maintenance
5. Laboratory
6. Administration

Each of these areas should receive instruction on specific topics, some of which are listed by area, as follows:

The management team should receive specific instructions on (1) management fundamentals including such topics as planning, directing, delegation, evaluation of programs and employee performance, negotiations and an approach to utilizing human resources including administering praise and reprimands; and (2) facility-specific management systems.

The supervisory team includes all second-level management personnel such as assistant managers, directors, supervisors and foremen. Their training should include such topics as (1) facility-specific management systems; (2) supervisory fundamentals in planning, directing, delegation, evaluation of results and employee performance; (3) all operations training topics; (4) all maintenance training topics that are applicable to their area of responsibility; and (5) safety.

The Operations personnel would receive instruction specific to their responsibilities. It is important that they receive both a broad understanding of the total facility and specific instruction on the individual unit processes. Some of these topics include (1) theory of wastewater treatment (general); (2) specific instruction utilizing the previously prepared O&M manuals and unit process standard operating procedures (SOPs); (3) selected facility-specific management systems; (4) objectives of plant operations and the mission of the facilities; (5) proper sampling techniques; and (6) safety.

The Maintenance division personnel would receive their training throughout the start-up and debugging phases of the program. Specific topics should include (1) selected facility-specific management systems with emphasis on the maintenance management system (MMS) and the maintenance department role; (2) hands-on instruction coordinated with the equipment suppliers' startup and training requirements on such equipment as pumps, bearing replacement, proper pump packing techniques, proper lubrication procedures, rigging, how to perform proper preventive maintenance, safety and other topics related to maintenance.

The laboratory employees' training is based on the service they provide to support effective process control. Specific topics should include (1) selected facility management systems with emphasis on the sampling and analysis plan (SAP); (2) sampling procedures and techniques; (3) laboratory data management (part of the facility-wide management information system [MIS]); (4) all operations division topics; (5) specific laboratory analysis procedures; (6) laboratory QC/QA procedures and programs; and (7) safety.

The Administration division personnel would receive training specific to their individual assignments as required. In addition to improving their over all understanding of process as a service function to the facilities, training would include (1) selected facility-specific management systems; (2) roles of the various sections; and (3) roles of the various units within their section.

As outlined above, the four divisions will each receive a different type of training; however, there should be some information passed through the program to provide knowledge to all employees regarding the functions of each division and their roles in the mission of the complex, i.e.:

1. Present Operations personnel must operate the existing facilities until the new primary facilities are constructed and fully operational. This group, plus any needed new employees, would receive training to operate the new primary and residual facilities when they come online in 1995. This expanded group will become the key personnel for the new secondary and expanded residual facilities scheduled to begin operating in 1999, and will be appropriately trained. New employees being added to the staff prior to the completion of the 1999 facilities would be trained to operate all the new primary, secondary and residuals processes before being placed in the facilities to perform duties.

   It is expected that each member of the operating staff would receive a minimum of sixty hours of a combination of classroom and hands-on training.

Training Program Preparation

The final training program should be outlined. The topics required to assure effective control of the plant must be identified, and topics necessary to update existing staff and to aid in the actual preparation of lesson plans, O&M manuals, standard operating and maintenance

procedures, and other written products that support the program should be completed before training is started. The training should be supported by a variety of visual aids. The use of slides and flip charts are "old standard" techniques that still have value during the training of personnel; however, video tapes on in any topics, including operations, maintenance and management and supervision, are now used extensively. Other tapes could be made specifically on-site to provide site-specific information on selected topics. Another tool that should be considered is the preparation of interactive audio/visual programs, on discs, which cover very specific subjects in great detail. These programs should be viewed frequently by the trainee to maintain a high operational standard. This type of training visual aid is being used in many manufacturing facilities to assure accuracy and consistency in operational or maintenance procedures. The O&M manuals must be completed before the training program begins, and be prepared in a format and in sufficient detail to provide a textbook for the operation, maintenance and management of the facilities. The manual should be completed as a series of mini-manuals, each standing alone and covering the areas of operations, maintenance and management. The operations manual should be further divided into mini-manuals covering each unit process controlled by an operations control center. The maintenance manual should also be divided to cover the Maintenance Management System (MMS) and the storeroom area.

Training Available in New England

In cooperation with the New England Joint Training Coordinating Committee (NEJTCC), an organization involved in the development, planning and implementation of training programs for environmental systems operators, a survey was conducted of all training courses offered in New England over the past three years. This survey covered the states of Massachusetts, New Hampshire, Maine, Connecticut, Rhode Island and Vermont.

The results of the survey showed that out of the eighty-five course offerings for environmental systems operators in 1987, twenty-three of them were located in Massachusetts and only eight of these were in the field of wastewater treatment. These eight courses were conducted at the Massachusetts Bay Community College in Wellesley; the University of Lowell; the Amherst, Massachusetts wastewater treatment plant; and five other locations offered by the training center operated by the Massachusetts DEQE.

At this time, most of the training is delivered during a one-day seminar and is limited to basic wastewater treatment including chlorination, or certification review. No other courses are known to be offered including adult education programs in local high schools or vocational technical schools.

Training Alternatives

The approach to training a large staff, such as the one that the Deer Island Wastewater Treatment Complex will ultimately have, presents some unique problems. The actual training could take place according to any one of three location options:

1. On-site at Deer Island;
2. Off-site at a location convenient to the majority of the students;
3. Or a combination of the two.

The training available under any of the location plans would be similar. The off-site instruction would be hampered by the inability to perform hands-on training using the equipment and facility that the student will eventually work with. It is extremely important to the majority of the trainees that they receive both classroom and hands-on on-site training. The use of facilities other than Deer Island would be extremely limiting to the training program because of the type of treatment taking place at, and the size and location of, the Deer Island Treatment Plant.

The on-site training could be completed following one of three approaches:

1. An outside contractor could perform the training program, and the treatment plant training staff could participate as a part of the contractor team. This approach would provide a learning experience for the plant training staff in the preparation of training materials, lesson plans, visual aids, instruction and organization of future programs. The staff could also provide evaluation of both the instructors and trainees to ensure that effective training is carried out.

2. An outside contractor could provide the training alone. The contractor would set up the temporary training center; prepare the materials; provide instruction, both classroom and hands-on; and provide an evaluation system.

3. The Authority's staff could provide the training alone. The staff would perform the complete program described above.

The three training options listed above could be performed off-site, but would be complicated by the absence of the equipment and facilities for hands-on training. It is possible to establish a training center in a conveniently located community college, a university, or a vocational or high school that participates in adult education programs, but the site and installed equipment would not be available to the instructors or the students for hands-on training and familiarization.

Recommended Approach

The recommended approach is based on the suggestion that all training, with the possible exception of some of the administration and laboratory training, will be performed on-site. The program should be developed, prepared, presented and reinforced based on the equipment and facilities being placed into operation both in 1993-1995 and in 1999. Both programs would be started about 6 months before the start-up date of the facility. As a result of the construction completion schedule, the program will be presented twice with major expansion, enlargement and reinforcement to cover the complete facility in 1999. It is suggested that

both programs be conducted according to a phased approach, incorporating the following elements:

Phase I

Areas requiring special attention during this phase are management and supervisory training. Heavy emphasis should also be placed on the development and delivery of a maintenance training program. This program should begin as soon as the prototype organization is established and key managers and supervisors are in place. The program should be repeated 10 months prior to the 1995 and 1999 start-up dates.
All other training programs should be developed for the primary plant during this phase.

It is also recommended that a pretest for all existing facility personnel be conducted immediately after adoption of the prototype organization. The pretest is very important because the programs and lessons that will be prepared for upgrade training will be tailored to individual employee strengths and weaknesses. The pretest will also assist the Authority in staff placement and in determining its hiring needs.

The evaluation protocol for all training should be established and put in place to ensure the successful completion of the program.

Phase II

In this phase, all prestart-up classroom-type training will be given to the existing staff and new employees. Familiarization with the facilities and the equipment should also be developed. This phase would begin approximately four months prior to start-up and would be completed within 60 days.

Phase III

All hands-on training timed to coincide with the actual start-up of the equipment will be completed in this phase. This phase must begin about 60 days prior to start-up and be completed within 90 days (30 days after start-up).

Phase IV

Reinforcement of the previous training based on start-up and operating experience at the facilities should be initiated as needed about 120 days after start-up and be completed within 45 days.

Phase V

A second reinforcement training period should be initiated about 270 days after the start-up and be completed within 60 days.

The issue of procuring staff, and the development and training of staff in a facility this large and complex, must also follow a well-defined procedure within the above phases to ensure that all elements and personnel are in place when required. The specific steps of this procedure will be included when the detailed Plan of Operation is prepared during the design phase of the project. Some of these steps were discussed previously, but are repeated and included here to show the complete procedures and to emphasize their importance. The suggested procedure includes the following:

1. The organizational structure must be adopted by management as the arrangement necessary to accomplish the mission of the facilities complex and provide direction for staff development and training.

2. For each position shown on the organizational chart, a position description that lists the types of duties that must be performed, and the qualifications required of the person filling the position, must be prepared.

3. Salary schedules and benefit packages that provide adequate compensation for the duties performed by each position shown on the organizational chart must be prepared and adopted. When establishing salaries at the Deer Island Plant, considerations should include:

   (a) pay for like positions in other, similar facilities;
   (b) Boston economic climate;
   (c) required position qualifications including certification; and
   (d) incentives to attract employees to make the commute to the Deer Island Plant.

4. Staffing needs must be determined for the existing facility, the phased operations and the final facility's start-up and operations as discussed and illustrated previously in this section of the facilities plan.

5. The development and preparation of training programs and materials must be completed before the placement of the staff in the prototype organization of the facility is begun. These programs and materials will be prepared for two different groups of students (existing and new hires) and should cover the tasks identified in the various position descriptions. The students will fall into one of two training groups:

   (a) Existing staff working in the present facilities who will be placed in a position on the new prototype organizational chart, based on their qualifications, and will receive upgrade training. This part of the training program will include the various operations and maintenance functions, installed equipment, policies and management systems for both the existing and new facilities.

   (b) New staff procured and placed, as defined earlier in this section of the report, into vacant positions in the organizational structure. This group will receive

entry-level training on the functions of the facility, equipment, policies and management systems similar to the training received by the above group.

Training materials must be procured and/or prepared to support the training programs. The programs will be outlined and topics identified for each of the sections in the organizational structure including:

- o Operations
- o Maintenance
- o Administration
- o Laboratory.

The program will be broken down further to define specific topics, both those that are common to all sections and those that are specific to each section, such as:

- o Management Training
- o Supervisory Training
- o Treatment Overview and Theory
- o Process Control
- o Maintenance Training
- o Administrative Procedures
- o Sampling Procedures
- o Authority Policies
- o Management Systems

The preparation of policies and procedures, to provide the foundation for personnel stability and for use in the training program, are an essential element in the proper training of the Deer Island Plant personnel. A good example would be a Personnel Policy Manual. This manual should answer most qustions that the staff may raise regarding working conditions, benefits, timekeeping, records, etc., and provide continuity for handling other personnel matters for management and supervisory teams as they carry out the task of staff development.

Management systems, in addition to the policy manual, will provide a concerted effort to establish stability and direction for meeting the goals of the facilities. These systems should be developed along with the personnel policy manual. These systems can cover many items; a few of the most important follow:

(a) Process Control System (PCS) that designates those responsible for making process control decisions; those who should be informed of these decisions; personnel making the process changes; parameters that are required to be met by each individual unit process; and who will be held accountable for proper performance of the unit processes.

(b) Maintenance Management System (MMS) that includes a master list of equipment included in the system; an equipment numbering system; a communications system that notifies the maintenance division of the need for maintenance; a work order system; a preventive maintenance program including a lubrication program; and an inventory system, providing parts and supplies, that supports the proper maintenance of the equipment, buildings, grounds and vehicles.

(c) A Management Information System (MIS) that identifies what "needs-to-know" information will be received by whom in the organization and when it must be available for that person to effectively perform his/her job.

(d) Sampling and Analysis Plan (SAP) that identifies the sample points; size and type of sample; sampler size; frequency of sampling; analysis for each sample point; and other related information.

(e) Data Management System (DMS) that indicates information to be recorded; who will record it; who will receive it; what kinds of reports will be generated; and what these reports will contain. In general, this system will establish the flow of information throughout the organization, based on what different areas and/or people need to know in order to do their jobs.

(f) Emergency Operations Plan (EOP) - this system will establish the vulnerability of different equipment, processes and areas of the plant in emergency situations and what the nature of those situations might be. It should describe the actions that must be taken in a number of different types of emergency situations and should establish whose responsibility it is to react to them.

These systems and procedures should be prepared under a contract with a consultant who has experienced operations and maintenance personnel on his staff. The Deer Island facilities management staff should also be involved in the preparation and review of systems and procedures to ensure understanding and proper use when the facilities are placed in operation.

6. A review of the qualifications of all existing personnel, using the new prototype organizational charts and position descriptions as guidance, must be made in preparation for the actual placement of staff to operate and maintain the new facilities. The results of this review will be to place personnel into the new organizational structure in the positions in which they have the greatest opportunity to succeed, based on their qualifications. These personnel will be trained based on their past experience and according to the requirements of the positions they will occupy in the new facilities. This group should provide the foundation and stability for staff development and facility performance required until newly-hired personnel can be placed, trained and have the opportunity to acquire some experience.

It is suggested that new personnel required to maintain the needed staffing levels also be hired and placed into the vacant positions in the new organizational chart at this point in the program. Each new employee will receive appropriate training before being placed in the facility for duty.

7. The last step of this procedure will be the actual presentation of the training program to all personnel as outlined and prepared previously. The training must include both classroom and hands-on training to be effective and to impact the actual operation and control of the facility.

8.2.3 ROLE OF CONSTRUCTION MANAGER AND LEAD ENGINEER

A project of the size and scope of this project will have both a Construction Manager who will coordinate and direct all construction activities including equipment installation and testing by equipment vendors, and a Lead Engineer who will coordinate all activities including construction engineering and continuing facility operations during the entire project. Both of these functions must include interfacing and assistance with the total training package. The classroom and hands-on training performed by the training contractor uses and coordinates into its program the training received from equipment suppliers and other vendors during the construction process. This training is particularly valuable to the operations and maintenance staff's first-hand understanding of the new equipment being installed.

The Lead Engineer assists in coordinating all of these activities. Particular attention must be paid to maintaining the operation and maintenance of the existing facilities while the new facilities are being constructed. This presents excellent training opportunities to help both new and existing personnel understand the process equipment during the manipulation of the facilities during this period.

This training can also be enhanced by involving the facility's supervisory staff during the construction prestart-up, start-up, and debugging of the facilities. Key supervisory staff should be hired during the design phase of the project so that they can participate in the design and construction process. Effective training is provided to supervisory personnel when they are included in the design review process and the construction phase. It is recommended that the electrical and mechanical supervisors become assistant inspectors to the construction inspectors hired by the construction management contractor.

8.2.4 TRAINING PROGRAM SIZE AND ESTIMATED COSTS

This training program, driven by the need for immediate upgraded training of the existing staff (about 200 people), the numbers of new staff required before 1995 (about 225 more), and the additional changes and staff required in 1999 (about 350 above present levels), is probably the largest wastewater treatment plant training program that will be undertaken in the next 10 to 12 years in the United States. The location of the facilities, in conjunction with the other factors impacting the training program, calls for the actual approach to and implementation of

this project to be different and somewhat innovative. The construction program being performed on a site of limited size will dictate the necessity of establishing a temporary training facility on the site by using mobile-home-type units fit together and sized to provide the contractor with preparation space and classrooms for actual instruction.

Based on training experiences in other facilities, and incorporating an escalation of the costs of those programs to present-day numbers, it is estimated that this training program for some 540 people will cost between $10 and $12 million dollars. The cost includes all expenses including temporary classrooms, contractors' offices, material preparation, instructors and other miscellaneous expenses.

8.3 PRELIMINARY OPERATIONS PLAN

Construction grant funding requirements necessitate the preparation of a plan of operations during the design and construction of treatment facilities. The plan is intended to identify those steps required for cost-effective, efficient, and reliable start-up and continued successful operation of the treatment facilities. The plan provides a concise description and implementation schedule, compiled in chronological order, of the major items required to ensure a successful start-up and operation. (See Table 8.3-1)

Items addressed in the plan of operation are proposed O&M budgets, including provisions for salaries and benefits to attract qualified personnel to run the proposed facilities; a financial management system; a staffing and staff training plan; an emergency operations program; development of a maintenance management system; start-up schedules and procedures; preparation of O&M manuals; and the development of an operations and maintenance program coordinating all of the O&M activities of the new and existing wastewater treatment facilities. Procedures and formats for reporting laboratory results, treatment plant performance, and general recordkeeping are also addressed.

The actual plan of operation is prepared in two steps. A preliminary plan is prepared during the design phase and presents a schedule of required events in terms of the number of days prior to the initiation of operations. A final plan is prepared during construction and must be completed prior to the mid-point of construction activities. The final plan details dates for the completion of tasks within the plan along with detailed information pertaining to identification of personnel who will perform various tasks within the plan.

A conceptual plan of operation, addressing items which will ultimately be detailed in the preliminary and final plan of operations during the design and construction phases of the project, was prepared as part of this facilities plan. The conceptual plan identifies items related to staff development which must be addressed during the period leading to actual construction of the recommended treatment facilities, and describes how these issues tie into the general start-up of the facilities. This will assist in enabling the MWRA to anticipate staffing needs throughout the period leading to full operation of the recommended facilities.

TABLE 8.3-1

DEER ISLAND WASTEWATER TREATMENT COMPLEX
PRELIMINARY PLAN OF OPERATION

Task	Estimated Start	Estimated Completion	Responsible	Completed By
Prepare Preliminary Plan of Operations	2/88	6/88	MWRA	Consultant
Final Plan of Operation				
o Primary	10/83	6/94	MWRA	Consultant
o Secondary	6/98	10/98	MWRA	Consultant
1. Staffing	6/88	5/89	MWRA	Consultant
o Needs	6/88	10/88	Consultant	Consultant
o Prepare Table of Organization	7/88	11/88	Consultant	Consultant
o Prepare Position Descriptions	9/88	2/89	Consultant	Consultant
o MWRA Approval	2/89	4/89	MWRA	Client Dependent
o Prepare Salary Schedule	12/88	4/89	MWRA/	Consultant Consultant
o Prepare Benefits Package	12/88	4/89	MWRA/	Consultant Consultant
o Prepare Hiring Schedule	2/89	4/89	Consultant	Consultant
o MWRA Approval	4/89	5/89	MWRA	Client Dependent
2. Training (Primary Plant)	5/94	12/95		
o Develop Outlines	5/94	12/94	Consultant	Consultant
o Submit to EPA and State Training Schedule	1/95	2/95	Consultant	Consultant
o Develop Lesson Plans and Visual Aids	10/94	5/95	Consultant	Consultant
o Implement	5/95	12/95	Consultant	Consultant
o Coordinate Manufacturer's Training	5/95	12/95	Consultant	Consultant

TABLE 8.3-1

DEER ISLAND WASTEWATER TREATMENT COMPLEX
PRELIMINARY PLAN OF OPERATION
(Continued)

	Task	Start	Estimated Completion	Estimated Responsible	Completed By
3.	Records, Reports and Laboratory Control (details omitted)	5/95	8/95	Consultant	Consultant
4.	Process Control and Startup Activities (details omitted)	6/95	12/95	Consultant	Consultant
5.	Emergency Response Plan (details omitted)	3/88	12/88	Consultant	Consultant
6.	Maintenance Management System (details omitted)	5/87	3/88	Consultant	Consultant
7.	Operations and Maintenance Manuals (details omitted)	1/94	6/95	Consultant	Consultant
8.	Operations and Maintenance Budget (details omitted)	1/92	9/92	MWRA	MWRA
9.	Ordinances, Permits & Industrial Wastes Program (details omitted)	1/87	10/88	MWRA	Consultant
10.	Safety Program (details omitted)	2/88	1/89	MWRA	Consultant
11.	Septage Receiving (details omitted)	3/88	10/88	MWRA	Consultant

The size of the proposed secondary treatment facilities will require the addition of significant numbers of staff and the operation and maintenance of facilities to which the existing staff is unaccustomed. Because of the importance of developing a quality staff for the operation of the recommended facilities and the difficulty anticipated in acquiring additional personnel due to the current lack of the required number of trained operators within the commuting area, the MWRA must begin to plan for the acquisition and training of this staff now.

The conceptual plan of operation includes critical items pertaining to staff acquisition and training, which must be completed in early phases of the project implementation, and follow-up activities related to the training of staff and the start-up of facilities.

Items pertaining to staff acquisition which must be addressed immediately by the Authority include the following:

1. Adoption of an organizational structure for management/operation of the new facilities.

2. Preparation of complete position descriptions, including duties and qualifications, for each position in the organizational structure.

3. Determination of staffing needs for start-up and operation of the phased facilities (by component based on construction scheduling - primary, secondary, etc).

4. Adoption of salary schedules and benefit packages per position and grade.

5. Development of programs to train staff to operate the new facilities.

These projects should be completed prior to the start of construction of the primary facilities in 1991. The procurement and placement of staff, including placement of existing staff into the new organizational structure, should be performed in time to allow the phased training programs to proceed during the construction of the new facilities.

Other elements of the conceptual plan which will be implemented between 1991 and the start-up of the various facilities include:

1. Records, Reports and Laboratory Analysis

This portion of the plan calls for the identification and preparation of a variety of check lists, log sheets, records and report forms that the operations, maintenance and laboratory personnel must complete to assist in the proper monitoring and evaluation of processes and equipment.

2. Process Control and Start-Up Activities

Key to proper start-up will be the preparation of the Process Control Management System (PCS) that will identify responsibilities of MWRA personnel in controlling the effective operation of the facilities. The identification of personnel who will establish the proper process settings, use of equipment, process troubleshooting, debugging and optimization of the various unit processes is essential. Sampling and laboratory analysis, data interpretation and process changes will be optimized throughout the start-up and facility takeover period. Coordination of this element with the various equipment vendors' testing period is essential to ensure equipment reliability and continuity during the start-up period.

3. Emergency Response Plan (ERP)

It is essential that facility performance remain efficient at all times regardless of any emergency situation. It is important that this management system be developed to address all emergency conditions to ensure continuing facility operation with minimal disruption. Various emergency situations must be identified and contingency plans detailed for alternate methods of operation, emergency repairs, first aid, firefighting, and storm response before such situations arise.

4. Maintenance Management System (MMS)

This element sets up the MMS necessary to assure timely correction of equipment problems, and establishes a preventive maintenance and lubrication program to provide longevity and minimize equipment breakdowns, as well as a maintenance-needs communications system to provide for response to problems that do arise. The equipment maintenance responses must be supported by a record system that both provides necessary basic information on each equipment item and identifies the work that has previously been performed through the maintenance system. All of the maintenance must be supported by an effective storeroom containing sufficient inventory to accomplish all the required work in a timely fashion. This management system becomes the heart of the effective operation of the facilities by providing equipment reliability through the participation of all facility personnel. The planning of the system must be completed prior to the installation and start-up of the equipment and its preparation must be scheduled so that it will be in place and workable prior to start-up.

5. Operation and Maintenance Manuals

These manuals must be prepared so that they can function as the textbook for the operation and maintenance training programs and as the reference manual for troubleshooting process problems. The information must be provided in a form that will help achieve and maintain high performance and efficiency levels at the facilities. These manuals are usually prepared with significant input from the design consultant, who has operation and maintenance staff with plant experience as a part of his team of designers; process consultants; and support groups such as electrical and instrumentation and construction managers who can help fit together meaningful information that provides long-term guidance to the facility operation and maintenance staff. These manuals should be prepared as a series of mini-manuals on the various unit processes,

maintenance, sampling and analysis, personnel policies and other elements important to the successful performance of the facilities. The timing of their preparation is essential to the training program and the establishment of the various management systems needed to meet effluent compliance goals.

6. Operation and Maintenance Budget

An adequate income and budget must be provided to support the functions of the recommended treatment facilities. The budget should be well thought-out and should be in place in time to support the activities that will provide effective and timely preparation, start-up and continuing operation and maintenance of the facilities.

7. Safety Program

A detailed safety program should be in place in the existing facilities, but must be revised and upgraded to meet the requirements and numbers of personnel in the new Deer Island facilities. It is also important that the new program be prepared and in place before the training programs begin for the new facilities.

The elements of the conceptual plan of operation are summarized in Table 11.5.3-2. The elements are subdivided into events which should be completed prior to 1991 and those which can be completed during the construction and start-up of the primary treatment facilities. A similar sequence will be required for the secondary treatment facilities, to be constructed and started up during the 1995-1999 period.

TABLE 8.3-2

CONCEPTUAL PLAN OF OPERATION

Task	Completion Date
Adopt organizational structure	|
Prepare position descriptions	|
Determine staffing needs	|----------1991
Adopt salary schedules and benefit packages	|
Develop training programs	|
Procure and place staff	|
Implement phased training programs	|----------1991 - 1995
Records, reports and laboratory control	|
Process control and Start-up activities	|
Emergency response plan	|
Maintenance management system	|----------1993 - 1995
Operation and maintenance manuals	|
Operation and maintenance budget	|
Safety program	|

Section 9

9.0 REGULATORY PLAN

This section describes recent legislative and regulatory changes which will influence MWRA's ability to finance, construct and operate the proposed secondary treatment facilities.

9.1.1 PHASE-OUT OF THE FEDERAL CONSTRUCTION GRANTS PROGRAM

The recently enacted Water Quality Act of 1987 provides for a transition from federally-funded construction grants for wastewater treatment facilities to state and local financing. The transition period extends from 1988-1994. During the initial years of this period, FY 1988 through FY 1990, federal grants totaling $9.6 billion nationwide will continue to be available. From FY 1990-1994, federal funds amounting to $8.4 billion nationwide will be available solely for establishing state revolving loan funds (SRFs) to provide ongoing assistance for construction of wastewater treatment facilities.

The 1987 legislation, therefore, directs the final phase-out of federal construction grants. The 1981 Clean Water Act had signaled the end of federal involvement by reducing the nationwide grants program by approximately 50 percent and lowering the federal contribution for individual projects from 75 to 55 percent. From 1972 through 1987, the federal grants program had provided $44 billion nationwide for the construction, operation and maintenance of wastewater treatment facilities. That era of federal largesse is unfortunately ending as MWRA begins its massive Harbor Clean-Up Program.

The end of the federal grant program also brings about a period of administrative uncertainty as state and local governments begin to assume the lead responsibility for project financing. As the federal grants programs are phased out, states, localities and Federal EPA will be redefining their roles in the financing of wastewater treatment facilities. States such as Massachusetts, which currently do not have revolving loan funds, must begin to evaluate the structure and regulations required for setting up and administering the loans. Federal guidance regarding the structure and procedures of SRF are still being finalized.

The transition towards greater state and local control has the potential for making the financing programs more responsive to local needs. However, the gain in local control is outweighed by the loss of grant money and its replacement by a loan fund.

9.1.2 CREATION OF STATE REVOLVING LOAN FUNDS

To replace federal grants for building wastewater treatment facilities, Congress authorized a new program to capitalize State Revolving Loan Funds (SRF) with federal funding assistance through 1994. The 1987 Clean Water Act includes an authorization of $8.4 billion nationwide for instituting SRFs. The major provisions pertaining to SRFs are:

- The complete transition from federal construction grants to state loans by 1990.

- The full capitalization of state loan programs by 1994 based on the following schedule of appropriation: (1) $1.2 billion for FY 1989; (2) $1.2 billion for FY 1990; (3) $2.4 billion for FY 1991; (4) $1.8 billion for FY 1992; (5) $1.2 billion for FY 1993 and; (6) $0.6 billion for FY 1994.

- The flexibility for states to request that a portion of the remaining construction grants be deposited in the SRF with a maximum of 50 percent in FY 1987, 75 percent in FY 1988, and 100 percent after FY 1988.

- The requirement of a 20 percent state matching contribution at the time of an SRF payment of an award from the federal government.

Congress has provided the states with discretion in structuring their SRF programs. Funds may be used to issue loans at or below market interest rates, including interest-free loans. SRFs also may be used to refinance or guarantee local bond issues, provide security for state bonds deposited in the SRF, or provide loan guarantees for similar SRFs established by municipalities or regional agencies.

However, the law does require that loan terms not exceed 20 years, that annual principal and interest payments commence no later than one year after completion of any project, and that all loans be fully amortized no later than 20 years after project completion. Payments must begin either within two years after funds were obligated by the state or three years after funds were allocated to the state by the federal government, depending on which event occurs sooner.

9.1.3 PHASE-OUT OF THE STATE CONSTRUCTION GRANTS PROGRAM

The Commonwealth of Massachusetts currently provides grants to cover 55 percent of the eligible capital costs for constructing wastewater treatment facilities. In conjunction with the existing 35 percent federal grant program, local communities may receive grants to cover 90 percent of the eligible construction costs.

The existing state grant program is scheduled to expire in 1988. The future structure of state aid for construction of wastewater treatment facilities is currently undecided as state officials review alternatives for instituting the SRF made possible under the new federal law.

9.1.4 SPECIAL CONGRESSIONAL AUTHORIZATION FOR THE BOSTON HARBOR CLEAN-UP

The 1987 Clean Water Act does contain a special provision which benefits the Boston Harbor Clean-Up efforts. The law authorizes the appropriation of $100 million targeted to the MWRA's program. Presently, the Congress has not appropriated any funds for FY 88 under this special legislation provision, and the other appropriation may be a victim of the Federal cutbacks required under the Gramm-Rudman-Hollings Act. The most recent Senate budget resolutions contain no appropriation, but local legislative leaders are optimistic that the House-Senate Conference will reach an agreement to provide at least $10 million for this fiscal year. If appropriated, the funds are available for the following activities:

- o Assessing the principal factors having an adverse effect on the environmental quality of Boston Harbor and adjacent waters.
- o Developing and implementing a management program to improve the water quality.
- o Constructing necessary treatment works for providing secondary treatment.
- o Undertaking emergency improvements to the Deer Island Wastewater Treatment Plant.

MWRA's current approach is to use this special appropriation for projects not covered by existing grant programs. The funds are particularly significant in financing such projects because the legislative provisions allow these federal dollars to be applied to 75 percent of the eligible costs.

The Authority's current plans are to spend $20 million in FY 1988, $40 million in FY 1989 and $40 million in FY 1990. For 1988, MWRA has proposed funding the following projects: (1) chlorination - $3.5 million; (2) sludge pump station - $6.0 million; (3) sewer metering - $3.5 million; (4) harbor research and monitoring - $2 million; (5) scum removal - $3.5 million and; (6) Deer Island water line - $1.0 million. The proposal has not yet been approved by Federal EPA. No proposals have been developed for the remaining $80 million.

9.1.4 INCREASED ENFORCEMENT AUTHORITY

The 1987 Clean Water Act enhances the criminal enforcement authority given to the EPA and provides the ability to enforce new civil penalties. The changes in criminal enforcement authority permit fines as high as $1 million and jail sentences of up to 15 years for certain intentional violations of the Act's provisions. Under the new civil penalties provisions, EPA can assess fines of up to $25,000 without bringing the case before an administrative law judge, and can fine as much as $125,000 when it does.

9.1.5 TAX REFORM ACT OF 1986

The provisions of the Tax Reform Act of 1986 concerning arbitrage will increase the Authority's financing requirements. Prior to the legislation, issuers of tax-exempt bonds were able to invest bond proceeds at a higher interest rate before the funds were actually expended. The interest gained from these investments was used to lower the total size of the bond issues, thereby reducing the borrowing requirements. This process, known as "arbitrage", is no longer allowable for tax-exempt issues under the new legislation. Public issuers are now required to rebate arbitrage earnings on tax-exempt issues to the U.S. Treasury. The penalty for failing to repay the arbitrage earnings is to lose the tax-exempt status of the issue. The reporting rules and procedures regarding arbitrage will require careful monitoring by the Authority to prevent its issues from being declared taxable.

9.1.6 LIMITED AUTHORIZED BONDING CAPACITY

Section 6(h) of the 1984 Legislative Act which created the Massachusetts Water Resources Authority confers the power "to borrow money and issue bonds and to pledge or assign or create security interests in funds or revenues of the Authority to pay or secure bonds." This right, however, is currently limited by Section 12(a) of the same Act which specifies that "the aggregate principal amount of all bonds issued under the authority of this Act, shall not exceed the sum of six hundred million dollars outstanding at any one time".

The cash flow analysis presented in Section 7.1 of this volume demonstrates conclusively that the proposed secondary treatment facilities cannot be constructed within the court-mandated schedule given the current limitation on the Authority's bonding capacity. A legislative amendment will be required for the Authority to obtain the capital financing required to construct the facilities.

9.1.7 ABILITY TO PRIVATIZE PROJECT COMPONENTS

As the MWRA begins to implement the recommendations of the Secondary Treatment Facilities Plan, some analysis should be conducted on the advantages and disadvantages of using the private sector to operate specialized facilities and/or to design and construct specific components on a "timely" arrangement. The facilities that should be examined to determine the applicability of "privatization" include the Deer Island power plant and the designs and construction of the outfall and associated diffuser. In the case of the power plant, the Authority might obtain significant financial advantages and acquire specialized management and operating capability by contracting with a private sector firm to design, construct, and operate the power facility. For the construction of the outfall system, an agreement with a single firm to both design and construct the facility may be needed to attract the specialized expertise needed to build the facility.

MWRA's Enabling Legislation neither provides clear authority nor hinders its ability to "practice" individual project components. Section 6 gives the Authority the right "to enter into contracts, arrangements and agreements with other persons in all matters necessary or convenient to the operation of the Act, including, without limiting the generality of the foregoing matters or technical cooperation, planning, management, administration and operations; and to recruit and deliver instruments necessary or convenient to the exercise of its powers under this Act. MWRA's Law Division should review this provision and the Enabling Legislation to determine whether more specific legislation provisions are required to utilize the private sector more fully in the design, construction, and operation of select project components.

9.2 POTENTIAL EFFECTS OF PROPOSED REGULATIONS

The United States Department of Environmental Protection (EPA) will be issuing proposed regulations on sludge management in reference to provisions of the 1987 Clean Water Act, which requires that EPA establish specific numeric criteria for toxic contaminants present in sewage

sludges. EPA is developing criteria for 41 different toxic compounds in sludge, which they will apply in four major categories of sludge disposal and/or processing: incineration, ocean disposal, landfilling, and land application. Given the statute's requirement that these pollutants not be "in concentrations which may adversely affect public health or the environment..." EPA intends to base the forthcoming criteria on very conservative assumptions.

Communities using or contemplating the use of incineration for sludge disposal will most likely face the most stringent criteria. Others who use direct (injection) or indirect (composting) land application methods for disposing sludges will face less stringent--but nonetheless difficult to meet--criteria. In many instances, the combined effects of the expanded number of parameters and the stringent criteria may result in many communities finding that their current or planned disposal method does not comply with the new rules. This may be particularly true for those communities that have sizable concentrations of industrial wastes in their sewage. Depending on the agreed-upon criteria, compliance may be difficult and costly. For this reason, MWRA must carefully monitor EPA efforts to develop criteria for toxic contaminants.

9.3 SUGGESTED MODIFICATIONS TO EXISTING LAWS AND REGULATIONS

The modifications to existing laws and regulations necessary for constructing the recommended facilities all pertain to capital financing mechanisms. The agenda of items requiring legislative action include:

- Creation of a State Revolving Fund which will supply loans at favorable below-market interest rates.
- Continuation (and expansion) of a State Construction Grants Program. Grants must be available at least at the current 55 percent level.
- Congressional appropriation of the $100 million authorized for the Boston Harbor Clean-Up in the 1987 Clean Water Act.
- Elimination (or substantial elevation) of the existing $600-million ceiling on outstanding Authority debt.
- Obtaining of clear legislative authority to contract, if deemed desirable, with private sector sum for the simultaneous responsibility of designing, building and/or operating some or all of MWRA's facilities.

As described in Section 7.1, the first two items - the availability of low-interest loans and state grants - will substantially alleviate the impact of the Harbor Clean-Up Program on local rate payers. The Congressional appropriation also will help local rate payers by providing funds for other MWRA projects in which rate payers would normally have to pay 100 percent of the cost. The final item, lifting the debt ceiling, is an absolute necessity if MWRA is to proceed with the multi-billion-dollar Harbor Clean-Up Program.

9.4 SUGGESTED MODIFICATIONS TO INTERNAL REGULATIONS

(to be inserted)

Section 10

10.0 OTHER INSTITUTIONAL CONSIDERATIONS

Implementation of the Deer Island wastewater facilities project will require a high level of coordination with the Authority's own capital projects and management initiatives as well as with other non-MWRA projects.

The related MWRA projects include:

- Mitigation Management -- the development of an internal management mechanism to ensure that the agency will carry out its commitments to the Winthrop, Boston, and Quincy communities.

- Infiltration/Inflow (I/I) Management Program -- the development of an Authority program to manage the level of I/I entering the wastewater treatment system, thereby enhancing the performance of the new facilities and diminishing the need to build additional capacity into the system.

- Harbor Monitoring Program -- the development of a research and monitoring system by scientists, public agencies and environmental groups to understand the current Harbor environment and assess the impact of various clean-up initiatives.

- MWRA Capital Projects -- a series of capital initiatives already begun by the Authority to upgrade the current treatment capability and to plan future programs for residuals management and CSOs.

The major external coordination requirement is to maintain close contact with the Central Artery/Third Harbor Tunnel project planned by the Massachusetts Department of Public Works (MDPW). Joint planning may uncover opportunities for cooperative projects, thus minimizing the combined impacts of the two efforts.

10.1 INTERNAL COORDINATION

10.1.1 MITIGATION MANAGEMENT

The success of the Deer Island facility and the overall reputation of MWRA will depend largely on its ability to be a "good neighbor" to those who reside near or are affected by its facilities. For the Deer Island project, the MWRA has made a commitment to mitigate the impact of the facilities during construction and operation. The commitment has been incorporated into the planning of the facility in the following ways:

- Construction Traffic Mitigation -- Bulk materials will be delivered and removed from the island primarily by water transport. Construction workers will enter and leave the site by ferry and buses from common staging areas.

- Traffic Impact, Operational Facility -- Materials used in plant operation will be

delivered via barge. Operations workers will enter and leave the site by ferry and buses from off-island sites.

- Noise Control -- Berms, temporary noise barriers, equipment mufflers and other techniques will be used to bring construction noise levels within or perhaps below standard levels. Permanent buffers also will be used to shield the adjacent communities from operational noises.

- Odor Control/Air Emissions -- Noxious elements of the plant will be located at maximum distances from residences and odor-reducing/air emissions control equipment will be installed and maintained.

- Visual Enhancements -- Although MWRA's formal commitments do not call for specific visual standards, the Authority has committed substantial resources to designing a facility and associated landscaping which will present a positive visual image.

Translating MWRA's commitment from design to construction and operating principles will require management-level supervision by the Authority. MWRA will need to designate a senior-level person to monitor the implementation of mitigation measures during construction. A permanent "ombudsman" will be needed to monitor compliance and handle community questions once the facility is operational.

10.1.2 INFILTRATION/INFLOW MANAGEMENT PROGRAM

MWRA is in the process of formulating an aggressive policy and program for managing system-wide infiltration/inflow. Infiltration/Inflow (I/I) is the clear water entering the sewer systems of both MWRA and its contributing communities through leaking pipes, catch basins, house-connections, roof leaders, manhole covers, sump pumps and tide gates. I/I enters the system for a number of reasons: (1) the sewer system of older communities were built with the purpose of receiving both wastewater and stormwater (inflow); (2) in other communities where "separate" sewers were constructed for wastewater, the deterioration of older systems allows infiltration; and (3) in some areas with high groundwater problems, homeowners connect sump pumps and other drainage devices to sewers intended for wastewater.

Although I/I does not contribute significant organic and solids loadings to MWRA's treatment facilities, it contributes a very significant portion of the total flow particularly during the high groundwater seasons. Estimates of the volume of I/I range from 30 to 70% of total flows. Preliminary estimates of flows for the new treatment facilities include an allowance for I/I at existing levels. The existing sewer systems are expected to deteriorate with time and thus MWRA will have to initiate an aggressive sewer maintenance and I/I reduction program to maintain status quo.

MWRA is committed to developing an I/I management program to reduce the demands on its proposed facilities. A successful program will result in significant savings in operating costs and may offer potential savings in long-term capital costs. Extensive coordination will be required between MWRA's facilities designers and the managers of the I/I program to ensure that

facilities are correctly sized for the region's future needs.

10.1.3 HARBOR MONITORING PROGRAM

As the implementation of the DIFP progresses, MWRA should continue to coordinate its activities with the scientific community and other interested parties to develop a research and monitoring program in Boston Harbor and Massachusetts Bay.

The proposed Bay Monitoring Program is intended to collect baseline scientific and technical data which can be used for resource management decisions and to monitor the effectiveness of programs undertaken to improve the water and sediment quality. The data collection efforts involve synthesizing existing data and using computer modeling techniques to fill important information gaps.

The Bay Monitoring Program is predicated upon the involvement of multiple public agencies, interest groups and scientists. MWRA can contribute to the program by sharing the environmental data collected during the facilities planning program, particularly from the outfall studies, and by supporting continued monitoring and research. Close coordination should be maintained by MWRA as the monitoring program progresses to ensure that MWRA's research efforts can contribute to developing the data base. In addition the monitoring efforts can help the Authority to design future programs for enhancing water quality.

10.1.4 OTHER MWRA PROJECTS

In addition to the Deer Island treatment facilities, the Boston Harbor Clean-up Program includes numerous other projects designed to upgrade and expand the MWRA's wastewater collection and treatment capabilities. These projects, described previously in section 3.3, include:

- Water Transportation
- Treatment Plant Upgrade
  - Nut Island Immediate Upgrade
  - Deer Island Fast-Track Improvements
- Interim Residuals Management
  - Interim Sludge Processing and Disposal
  - Interim Scum Management
- Long-term Residuals Management
- Combined Sewer Overflows

These projects have either a direct or indirect bearing on the design of the secondary treatment facilities. Those projects currently underway, such as the Treatment Plant upgrade and the Interim Residuals Management programs, will need to be coordinated carefully with the

DIFP to avoid construction-related conflicts.

10.2 EXTERNAL COORDINATION

10.2.1 COORDINATION WITH THE CENTRAL ARTERY/THIRD HARBOR TUNNEL PROJECT

The construction of the Deer Island Facilities will require extensive coordination with the Central Artery/Third Harbor Tunnel project as both projects have similar labor, equipment, materials, and disposal requirements. Close cooperation between the two projects is necessary to mitigate their impact and to capture the benefits achievable through selected joint activities. A preliminary list of issues common to both projects includes:

- Spoils disposal and permitting -- MWRA' project will involve the movement and use or removal of approximately 5.5-6.3 million cubic yards of excavated material between 1988 and 1995, with the majority removed between 1990 and 1994. Of this amount, approximately 1.0-1.6 million will require re-use at off-island sites, ocean disposal or off-island secured disposal. The Central Artery/Third Harbor Tunnel project will be excavating approximately 8 million cubic yards of material. This material also will require disposal or reuse. Depending on the timing of the two excavations, possibilities may exist for using common disposal areas.

  Another possible alternative, depending on the suitability of the material, might be to use MWRA's excavated material as backfill for the Central Artery/Third Harbor Tunnel Project. The latter project requires approximately 2 million cubic yards of backfill.

- Supply of Bulk Materials -- In addition to the need for backfill, another of the CA/THT's major bulk materials requirements is approximately 3 million cubic yards of concrete. MWRA's total concrete needs are estimated at 0.8-1.0 million cubic yards. The peak period for MWRA's consumption will be 1992-1993; CA/THT peak demand occurs from 1991-1993. As a result, if both schedules are maintained, 1993 will be peak demand years for both projects.

- Water Transportation -- The MWRA project possesses significant water transportation requirements because of the Authority's commitment to mitigate traffic impacts. A significant portion of the material, equipment and workers will be delivered to the project sites by overwater transportation. The Central Artery/Harbor Tunnel project also may require water transportation facilities for disposal of materials.

- Labor Supply and Labor Relations -- Both projects will have demands for similar labor skills and will need to negotiate common work rule issues (e.g. does the work day begin when the worker boards the bus or ferry, or when the worker reaches the job site?)

- Construction Sequencing -- Similar demands for labor, concrete and other items have the potential for increasing costs for both projects. Careful construction sequencing

may be able to alter the timing and sequencing of individual bid packages to prevent excess competition for specific skills, bulk materials and labor.

10.2.2 COORDINATION WITH REGULATORY AGENCIES

One of the major elements in the successful completion of MWRA's construction program will be the ability to maintain effective coordination with the federal and state regulatory agencies in permitting and mitigation activities. The project's permitting requirements, as described in Section 5.4, are substantial in total numbers and in the complexity of obtaining some individual permits. Obtaining permits also is a "critical path" item for beginning the early site preparation activities necessary to meet the court-order completion dates for the major project components.

As recommended in Section 6.6.2, an extremely effective way to ensure close interaction and monitoring of the regulatory process is to assign a liaison from US/EPA and the state DWPC to the proposed MWRA Program Management Unit. This arrangement will promote the type of effective partnership necessary to maintain the aggressive construction schedule.

Appendix A

Secondary Treatment Facilities Plan

Volume VII

Appendix A
Permit Fact Sheet

PERMIT FACT SHEET

NAME OF PERMIT

Environmental Impact Statement - Record of Decision (ROD)

AGENCIES

U.S. Environmental Protection Agency (EPA)

STATUTORY/REGULATORY AUTHORITY

National Environmental Policy Act (NEPA), 42 U.S.C. 4321
40 CFR Part 6, Section 102(2)(c)

APPLICABILITY

An Environmental Impact Statement (EIS) is the part of the facilities plan that examines and analyzes the environmental impacts of the alternative plans being considered for the treatment works.

The National Environmental Policy Act and the Council on Environmental Quality regulations require that Federal agencies include in their decision-making processes appropriate and careful consideration of all environmental effects of proposed actions, analyze potential environmental effects of proposed actions and their alternatives for public understanding and scrutiny, avoid or minimize adverse effects of proposed actions, and restore and enhance environmental quality as much as possible.

PROCEDURES

Environmental reviews are conducted by EPA. This process consists of a study of the action to identify and evaluate the related environmental impact. When an EIS is required, EPA has overall responsibility for the review, although grantees, applicants, permittees, or contractors will contribute to the review through submission of environmental information documents. After publishing a notice of intent to prepare an EIS, a scoping session is held and a draft EIS is prepared and distributed for review. Under Section 205(g) of the Clean Water Act, the facilities planning environmental review process should include EPA and appropriate state, regional, and water quality management agencies.

RELATED PERMITS AND ACTIVITIES

Federal permits which must be obtained in conjunction with this project include an NPDES permit, issued jointly by EPA and Massachusetts DEQE-DWPC, an Army Corps of Engineers permit, involving activities in or affecting navigable waterways, and an EPA Ocean Dumping Permit. Other approvals include a Federal Aviation Administration Notice of Proposed Construction or Alteration, a Notice of Intent to remove asbestos, and all state and local permits and approvals governing air, water, wetlands, coastal zone, and historical resources.

PERMIT FACT SHEET

NAME OF PERMIT

Ocean Dumping

AGENCIES

U.S. Environmental Protection Agency (EPA)

STATUTORY/REGULATORY AUTHORITY

Marine Protection, Research and Sanctuaries Act (33 U.S.C. 1401), Section 102

APPLICABILITY

Subchapter H of Section 102 of the Marine Protection, Research and Sanctuaries Act establishes procedures and criteria for the issuance of ocean dumping permits by EPA. Subchapter H also establishes the criteria to be applied by the Corps of Engineers in its review of activities involving the transportation of dredged material for the purpose of dumping it in ocean waters pursuant to Section 103.

PROCEDURES

Application for an ocean dumping permit is made to EPA. A tentative determination and public notice is made after 30 days. A 30 day comment period including: specific persons, state agencies, the Corps of Engineers, and Coast Guard, results in either a public hearing followed by a determination or a determination after 30 days. Based on the determination, a recommendation to issue or deny the permit is made. If a permit is recommended, the permit can be issued after 10 days (a copy should be sent to the Coast Guard). Adjudicatory measures may be initiated up to 20 days after a permit is issued.

RELATED PERMITS AND ACTIVITIES

A Corps of Engineers permit for activities in or affecting navigable waters is required for dredging and ocean transportation. In accordance with the consulted agency review and response, a Coastal Zone Management Program review is required.

PERMIT FACT SHEET

NAME OF PERMIT

Dept. of the Army

AGENCIES

U.S. Army Corps of Engineers (ACOE)

STATUTORY/REGULATORY AUTHORITY

Section 10 of the Rivers and Harbors Act of 1899 (33 U.S.C. 403)
Section 404 of the Clean Water Act (33 U.S.C. 1344)
Section 103 of the Marine Protection, Research and Sanctuaries Act of 1972 (33 U.S.C. 1414)
(Administered in accordance with 33 CFR Parts 320-330, Regulatory Programs of the Corps of Engineers)

APPLICABILITY

Structures or work in or affecting navigable and territorial waters of the U.S. are regulated by the Department of the Army. Under Section 10, where the Corps' jurisdiction extends landward to the mean high water elevation, permits are required for structures and/or work in or affecting navigable waters. Permits are required for the discharge of dredged or fill material pursuant to Section 404 of the Clean Water Act. Permits are required for the transportation of dredged material for the purpose of ocean disposal under Section 103.

The MWRA's Secondary Treatment Facilities Plan project will require the construction of structures in and under navigable and territorial waters (e.g., the inter-island and outfall tunnels) and may require filling, sediment dredging, and ocean transportation and disposal of dredged sediments.

PROCEDURES

The district engineer establishes local procedures and policies which are provided to the applicant in a pre-application consultation for Section 10, Section 404 and Section 103 permits. Within 15 days of receipt of an application for these permits, the district engineer will determine its completeness and, if complete, issue a public notice for a

30-day comment period. Based on public comments and federal agency review, the district engineer may require additional information or extend the comment period for an additional 30 days if warranted. Typically, the district engineer pursuant to NEPA evaluates the need for an environmental assessment or an environmental impact statement (EIS) along with the need for a public hearing. However, for the MWRA's Secondary Treatment Facilities Plan project, EPA is the lead federal agency and has announced its intent to prepare a Supplemental EIS for the Inter-Island Conveyance System and Outfall. The Corps will participate in this process and can issue the Dept. of the Army permit following EPA's issuance of a favorable Record of Decision (ROD).

RELATED PERMITS AND ACTIVITIES

Under the provisions of NEPA, either an Environmental Assessment and Finding of No Significant Impact or an Environmental Impact Statement is required.

Prior to issuance of the Corps permit, the applicant must have received a Water Quality Certification from DEQE, Division of Water Pollution Control, and the Coastal Zone Management (CZM) Consistency Concurrence from the Massachusetts CZM Office.

Section 404 activities are reviewed in accordance with guidelines promulgated by the Environmental Protection Agency under authority of Section 404(b)(1) of the Clean Water Act.

PERMIT FACT SHEET

NAME OF PERMIT

Notice of Intent for Asbestos Removal - Federal

AGENCIES

Environmental Protection Agency
Department of Environmental Engineering (DEQE) - Division of Air Quality Control
City of Boston

STATUTORY/REGULATORY AUTHORITY

Federal - Occupational Safety and Health Administration (OSHA) - 29-CFR Part 1910.1001
40 CFR, Part 61, Subpart M, Sections 61.147 and 61.152

State - M.G.L. Chapter 111, Section 142A-142E
310 CMR 7.02, 7.09 and 7.15

City of Boston - Codes

APPLICABILITY

An asbestos-containing waste may be generated during removal of friable asbestos materials from buildings. A friable material is one which is subject to pulverization by hand pressure when it is dry. The regulations address the removal of friable asbestos materials prior to demolition or renovation of buildings. Removal should also be considered for materials that may potentially become friable during the demolition or renovation activities. Currently, the federal regulations apply to larger structures with certain minimum quantities of asbestos containing material. Some state and local health agencies require removal of lesser quantities from smaller buildings.

When the asbestos materials are prepared for removal, they are wetted with water and a surfactant mixture sprayed in a fine mist. Once thoroughly wetted asbestos material has been removed from a building, regulations require the wastes to be containerized as necessary to avoid creating dust during transport and disposal.

The extent of asbestos requiring removal during the demolition or renovation of Deer Island facilities is unknown. Prior to actual demolition activities, the MWRA must perform a survey to quantify its presence.

PROCEDURES

To remove asbestos a Notification must be sent to DEQE Division of Air Quality Control, 20 days prior to the planned removal. The contractor must notify DEQE 72 hours prior to the removal with information including: date, handling procedure, and disposal location.

EPA must be notified of demolition activities involving asbestos. For amounts of asbestos less than 260 linear feet or 160 square feet, notification must occur 20 days prior to removal. Notification is required 10 days in advance for larger amounts. The notification must include the same information required by DEQE.

RELATED PERMITS AND ACTIVITIES

City of Boston construction permits must be obtained from the Fire Department, and possibly the Building Department and Board of Health regarding demolition activities and asbestos removal.

PERMIT FACT SHEET

NAME OF PERMIT

FAA Notice of Proposed Construction or Alteration

AGENCIES

U.S. Department of Transportation - Federal Aviation Administration (FAA), New England Region.

STATUTORY/REGULATORY AUTHORITY

Federal Aviation Act of 1958 Section 1101, as amended (49 U.S.C. 1101)
FAR Part 77

APPLICABILITY

The prime objective of the FAA in administering FAR Part 77 is to ensure the safety of aircraft and the efficient utilization of navigable airspace by aircraft. A second objective is the protection of persons and property on the ground, through appropriate revision of air traffic procedures and airspace use. The FAA must be notified of any of the following construction or alteration activities:

1. Any construction or alteration of more than 200 feet in height above the ground level at its site within 3 nautical miles of an airport with a runway more than 3,200 feet in length.

2. Any construction or alteration of greater height than an imaginary surface extending outward and upward at one of the following slopes:

   i. 100 to 1 for a horizontal distance of 20,000 feet from the nearest point of the nearest runway of each airport with at least one runway more than 3,200 feet in actual length.
   ii. 50 to 1 for a horizontal distance of 10,000 feet from the nearest point of the nearest runway of each airport with its longest runway no more than 3,200 feet in actual length.
   iii. 25 to 1 for a horizontal distance of 5,000 feet from the nearest point of the nearest landing and takeoff area of each heliport.

The FAA will determine whether such construction or alteration constitutes a hazard to navigation.

For the Deer Island secondary treatment facilities plan project, the applicable criteria are therefore listed in item 2.i. above. Since Deer Island is approximately 10,000 feet from the nearest runway at Logan Airport, any construction or alteration above about 115 feet mean sea level (221 ft MDC sewer datum) will require that a notification be submitted. This notification requirement will be reviewed as engineering design progresses.

PROCEDURES

Each person who is required to notify the Administrator under Section 77.13 (a) shall send one executed FAA Form 7460-1, Notice of Proposed Construction or Alteration, to the Manager, Air Traffic Division, FAA Regional Office having jurisdiction over the area within which the construction or alteration will be located.

The notice must be submitted at least 30 days before the earlier of the following dates -

(1) The date the proposed construction or alteration is to begin.
(2) The date an application for a construction permit is to be filed.

The FAA will acknowledge each notice after an initial screening. The outcome of the review may result in a number of determinations, including FAA Form 7460-9, Determination of No Hazard to Air Navigation.

RELATED PERMITS AND ACTIVITIES

None

PERMIT FACT SHEET

NAME OF PERMIT

Private Aid to Navigation Permit

AGENCY

U.S. Coast Guard

STATUTORY/REGULATORY AUTHORITY

33 CFR 64 - Wrecks and Obstructions
33 CFR 66 - Private Aids to Navigation

APPLICABILITY

The placing of fixed and floating aids to navigation is of particular interest to the Coast Guard because of its control of marking, lighting, standardization of such navigation aids, and the provision of information to mariners. Temporary and permanent structures or activities associated with the Deer Island project which potentially affect navigation may require a Private Aid to Navigation Permit.

PROCEDURES

Consultation with the U.S. Coast Guard before the intended construction or activity commences is recommended in completing the standard application. The application should detail the location, communication (radio frequencies), and project duration issues related to the proposed structures or activities. Upon completion of the application, it must be forwarded to the Massachusetts Office of Coastal Zone Management for review and formal submittal to the U.S. Coast Guard.

RELATED PERMITS AND ACTIVITIES

The Aid to Navigation Permit is consistent with the U.S. Army Corps of Engineers Permit for Structures or Work in or Affecting Navigable Waters as required under 33 CFR 322.5(e).

PERMIT FACT SHEET

NAME OF PERMIT

EOEA Certificate

AGENCIES

Massachusetts Executive Office of Environmental Affairs (EOEA), MEPA Unit

STATUTORY/REGULATORY AUTHORITY

M.G.L., Chapter 30, Sections 61-62H

301 CMR 11.0

APPLICABILITY

301 CMR 11.0 was promulgated in order to create a uniform system for compliance with the Massachusetts Environmental Policy Act (MEPA). MEPA, and these regulations, apply to the activities of all agencies of the Commonwealth, to all activities carried out with financial assistance from agencies, and to all activities which require permits granted by agencies. M.G.L. c. 30 s. 61 requires review and evaluation of projects with regard to environmental impact and further requires that agencies find that all feasible means and measures will be used to avoid or minimize damage to the environment.

The MWRA's Secondary Treatment Facilities Plan project is required to submit an Environmental Notification Form (ENF).

PROCEDURES

301 CMR 11.00 establishes thresholds, a procedure, and a timetable for a two-level review process, which generally proceeds as follows: If a project exceeds review thresholds, the project proponent begins the review process by preparing and filing an Environmental Notification Form (ENF) with the Secretary of Environmental Affairs (Secretary). A thirty-day review period follows, during which the Secretary receives agency and public comments and holds a site visit and consultation session. At the close of the ENF review period, the Secretary determines whether an Environmental Impact Report (EIR) is

necessary. If an EIR is required, it is prepared by the proponent and submitted to the Secretary. The EIR is reviewed and commented on, at both draft and final stages, by agencies, the public, the MEPA Unit, and the Secretary. After completion of the Secretary's review of a final EIR and expiration of a 60-day legal challenge period, agencies may act on the project.

The MWRA submitted the ENF for the Deer Island project on June 24, 1986. On August 8, 1986, the Secretary certified that the project requires the preparation of an EIR and concurred with MWRA's request for a "major and complicated" project designation (301 CMR 11.12). This designation allows the Secretary to establish project-specific procedures to facilitate the environmental reviews. The Secretary issued these procedures on November 21, 1986. The procedures established a review schedule for project documents and a Citizens' Advisory Committee to provide advice, recommendations, and input to the Secretary.

RELATED PERMITS AND ACTIVITIES

Federal review under the National Environmental Policy Act (NEPA) is being led by the U.S. Environmental Protection Agency.

All state permits cannot be issued until the Secretary has issued the MEPA certificate on the Final EIR.

PERMIT FACT SHEET

NAME OF PERMIT

Water Quality Certification

AGENCIES

Department of Environmental Quality Engineering (DEQE), Division of Water Pollution Control (DWPC)

STATUTORY/REGULATORY AUTHORITY

Federal - Clean Water Act, 33 U.S.C. 1341 (Section 401)

State - M.G.L. Chapter 21, Section 27 (12).
DEQE regulations are contained in 314 CMR 4.00 and 314 CMR 9.00

APPLICABILITY

Any project requiring a federal or state license or permit to conduct activities which may result in a discharge to waters of the United States must be evaluated for compliance with applicable effluent limitations and water quality standards, during the construction and subsequent operation of the proposed facility. State certification must be obtained before a license or permit may be issued. Such activities include NPDES regulated discharges, dredge and fill operations, and the construction of structures in the water.

PROCEDURES

This process is initiated as a part of other permitting processes.

RELATED PERMITS AND ACTIVITIES

The applicant must have filed for a federal or state license or permit for a project which may result in a discharge to waters of the United States.

The permit is always associated with some other license or permit such as an NPDES Permit, DEQE Chapter 91 Waterways License, or a Corps of Engineers Permit for Activities in Navigable Waters.

PERMIT FACT SHEET

NAME OF PERMIT

Chapter 91 Waterways License

AGENCIES

Department of Environmental Quality Engineering (DEQE), Division of Waterways

STATUTORY/REGULATORY AUTHORITY

M.G.L. Chapter 91, Sections 12-23.
Regulations are in 310 CMR 9.00, Administration of Waterways Licenses

APPLICABILITY

Any structure constructed seaward of the high tide line in tidal areas, or in or over any great pond or any river or stream on which there have been government expenditures of money, must be licensed. Tidelands generally extend from the low water mark to the three-mile limit of territorial waters.

The program protects the public's rights in the waters of the Commonwealth and to the land under those waters. Generally, the people of the Commonwealth own the land below low water in tidelands and beneath great ponds. Structures may be built on those lands that benefit the public's rights and do not harm the public interests in any way. The right to navigate in the waters over these lands is especially important.

PROCEDURES

The applicant must submit plans and specifications prepared by a professional engineer to the DEQE. The DEQE must notify the selectmen in the affected town and consider their comments. The DEQE reviews the plans and informs the applicant if a license is to be granted. The applicant pays the appropriate fee, receives the license, records it, and then may commence construction. The fee is:

1. For any structure below high water in tidewaters there is a fee of $2.00 per cubic yard of tidewater displaced.

2. For any structure in Commonwealth tidelands there is a fee of $2.00 per square foot of land occupied. Generally, Commonwealth tidelands extend from the low water mark or 100 rods (1650 feet) seaward of high water, whichever is nearer to land, to the three-mile limit.

RELATED PERMITS AND ACTIVITIES

The applicant must have filed a Notice of Intent with the local conservation commission under the Wetlands Protection Act prior to filing for a license and must have received an Order of Conditions prior to receiving a license. A Water Quality Certification is issued as part of the license. DEQE must act on this permit within 60 to 90 days of MEPA's Notice of Availability of the Final Environmental Impact Report.

The project must receive a Water Quality Certification from the DEQE, Division of Water Pollution Control. This procedure is initiated by the Division of Waterways.

Prior to construction the applicant must also receive a permit from the U.S. Army Corps of Engineers. This permit will generally not be granted until after the state license is granted.

PERMIT FACT SHEET

NAME OF PERMIT

Dredging and Disposal of Dredged Material Permit

AGENCIES

Department of Environmental Quality Engineering (DEQE) Division of Waterways

STATUTORY/REGULATORY AUTHORITY

M.G.L. Chapter 21A, Section 14 and Chapter 91, Sections 2, 52, 53, 54, 55, and 63. Regulations are contained in 310 CMR 9.00.

APPLICABILITY

No person may dredge in the tidewaters of the Commonwealth or dispose of any dredged materials therein without a permit from the DEQE. Tidewaters generally extend from the low water mark to the three mile limit of the territorial waters.

This program protects the public interest in the tidewaters of the Commonwealth, especially water quality and navigational safety. No dredged materials may be disposed of in a way that would harm water quality, degrade the environment, damage or destroy any known archaeological resources, or harm public health.

PROCEDURES

The applicant must submit plans and specifications prepared by a professional engineer to DEQE.

RELATED PERMITS AND ACTIVITIES

This permit would be issued as part of the Chapter 91 Waterways License for structures, if required. The applicant must have filed a Notice of Intent with the local conservation commission under the Wetlands Protection Act prior to filing for a permit and must have received an Order of Conditions prior to receiving the permit. A Water Quality Certification is issued as part of the permit. DEQE must act on this permit within 90

days of MEPA's Notice of Availability of the Final Environmental Impact Report.

A Water Quality Certification from the DEQE, Division of Water Pollution Control, is required. The DEQE will initiate this procedure.

Any dredging project in navigable waters will also require a permit from the U.S. Army Corps of Engineers. This permit will generally not be granted until after a state permit is granted.

If an NPDES permit is required, discharges must meet water quality standards established by DEQE.

PERMIT FACT SHEET

NAME OF PERMIT

Notice of Intent for Asbestos Removal - State

AGENCIES

Department of Environmental Engineering (DEQE) - Division of Air Quality Control
City of Boston

STATUTORY/REGULATORY AUTHORITY

Federal - Occupational Safety and Health Administration (OSHA) - 29 CFR Part 1910.1001

State - M.G.L. Chapter 111, Section 142A-142E
310 CMR 7.02, 7.09 and 7.15

City of Boston - Codes

APPLICABILITY

An asbestos-containing waste may be generated during removal of friable asbestos materials from buildings. A friable material is one which is subject to pulverization by hand pressure when it is dry. The regulations address the removal of friable asbestos materials prior to demolition or renovation of buildings. Removal should also be considered for materials that may potentially become friable during the demolition or renovation activities.

When the asbestos materials are prepared for removal, they are wetted with water and a surfactant mixture sprayed in a fine mist. Once thoroughly wetted asbestos material has been removed from a building, regulations require the wastes to be contained as necessary to avoid creating dust during transport and disposal.

The amount of asbestos requiring removal during the demolition or renovation of Deer Island facilities is unknown. Prior to actual demolition activities, the MWRA must perform a survey to quantify its presence.

PROCEDURES

To remove asbestos a Notification must be sent to DEQE Division of Air Quality Control, 20 days prior to the planned removal. The contractor must notify DEQE 72 hours prior to the removal with information including: date, handling procedure, and disposal location.

RELATED PERMITS AND ACTIVITIES

City of Boston construction permits must be obtained from the Fire Department, and possibly the Building Department and Board of Health, regarding demolition activities and asbestos removal.

PERMIT FACT SHEET

NAME OF PERMIT

Approval to Modify or Construct a New Source of Air Contaminants

AGENCIES

Department of Environmental Quality Engineering (DEQE), Division of Air Quality Control.

STATUTORY/REGULATORY AUTHORITY

M.G.L. Chapter 111, Section 142A-142E
U.S. Clean Air Act, 42 USC 7401 et. seq.

310 CMR 7.00 - Massachusetts Air Pollution Control regulations

APPLICABILITY

Any proposed new or modified source of air contaminants (which include carbon monoxide, hydrocarbons, nitrogen oxides, sulfur dioxide, particulate matter, volatile organic compounds, and any pollutant covered by the National Emission Standards for Hazardous Air Pollutants promulgated by the U.S. Environmental Protection Agency) must be approved. The review specifically applies to the following types of sources, as well as any other type of facility as the DEQE may require:

Incinerators; fossil fuel utilization facilities having energy input capacities greater than three million (3,000,000) BTU per hour; industrial facilities such as asphalt batching plants, foundries, chemical products manufacturing plants, petroleum products manufacturing plants, aggregate manufacturing plants, food and food products plants, wood products plants, dry cleaning establishments, paint and varnish manufacturing plants, paper manufacturing plants, leather manufacturing plants, concrete manufacturing plants, and metal coating and treating plants; hand-fired solid fuel facilities greater than 150,000 BTU per hour; stationary nuclear sources; and any organic-material storage and loading facilities handling materials with vapor pressures between 1.5 to 11 lbs. per square inch or higher.

If the proposed site of the new or modified source is in an area designated as an "attainment" area or may significantly impact an attainment area for any pollutant which the source will emit, the source may also require a "PSD" (Prevention of Significant Deterioration) approval. If the source is in a "non-attainment" area for a pollutant (e.g. Boston is a "non-attainment" area for ozone) for which the source would be classified as "major", then a non-attainment review must be conducted to ensure the greatest degree of emission control possible and emission offsets from existing sources would have to obtained.

For MWRA's Secondary Treatment Facilities Plan project, the facilities regulated may include additional fossil fuel utilization facilities for on-site power generation, if required; the wastewater treatment system as it relates to volatile organic compounds (VOC) and air toxic emissions; and construction equipment such as an on-site concrete batch plant. The need for PSD approval or non-attainment review will be evaluated as preliminary engineering design progresses.

PROCEDURES

The DEQE requires that potential sources of air contaminants submit plans, specifications, proposed Standard Operating Procedures, and proposed maintenance procedures for any new or modified facility. The DEQE's review is intended to determine conformity with state and federal regulations, including emission limitations contained in Massachusetts regulations, Federal New Source Performance Standards (NSPS), and National Emission Standards for Hazardous Air Pollutants (NESHAPS), and assure of continued conformity with Massachusetts and Federal National Ambient Air Quality Standards (NAAQS). The DEQE will notify the applicant whether or not the application is complete.

RELATED PERMITS AND ACTIVITIES

DEQE must act on this permit within 60 to 90 days of MEPA's Notice of Availability of the Final Environmental Impact Report.

PERMIT FACT SHEET

NAME OF PERMIT

Approval of Residuals Disposal

AGENCIES

Department of Environmental Quality Engineering (DEQE), Division of Water Pollution Control (DWPC)

STATUTORY/REGULATORY AUTHORITY

M.G.L. Chapter 21, Sections 43; M.G.L. Chapter 83, Section 7

314 CMR 12.00

APPLICABILITY

No person shall construct, operate, or maintain wastewater treatment works without the approval of the DWPC. This jurisdiction includes any facilities necessary for the proper disposal of waste residuals emanating from such facilities. Further, the discharge of pollutants to waters (including groundwater) of the Commonwealth without a valid permit from DWPC is prohibited.

The grit and screenings disposal areas which exist on Deer Island will be undergoing interim closure. Under the Secondary Treatment Facilities Plan, these areas of grit and screenings must be excavated, treated (if necessary), and disposed of either on-island or off-site, in order to make the areas available for the construction of new treatment facilities.

PROCEDURES

Residuals disposal activities require a separate approval not associated with the NPDES or discharge to groundwater permits. The residuals disposal approval is associated with the regulation of the wastewater treatment plant. Approval procedures involve submittal of an

approval request letter with accompanying information for DEQE-WPC review. (Under 314 CMR 3.12 - Modification, Suspension, Relocation, and Renewal of Permits - DEQE is not required to follow the permit review procedures set forth in 314 CMR 2.00.).

RELATED PERMITS AND ACTIVITIES

DEQE's regulations for the disposal of solid wastes by sanitary landfill (310 CMR 19.00) are not directly applicable; however, DWPC may use these regulations as guidance in ensuring an environmentally acceptable project.

PERMIT FACT SHEET

NAME OF PERMIT

Section 106, Historic Preservation Review

AGENCIES

Advisory Council on Historic Preservation (the Council) and Massachusetts Historical Commission (MHC)

STATUTORY/REGULATORY AUTHORITY

Federal - 16 U.S.C. 470 (Section 106) National Historic Preservation Act

State - M.G.L. Chapter 40c
950 CMR 71

APPLICABILITY

Any federally-assisted or federally-licensed project which might affect properties listed or eligible for listing in the National Register of Historic Places must complete the Historic Preservation Review process.

The MWRA's Secondary Treatment Facilities Plan project may involve demolition, relocation, or adaptive reuse of several on-site structures which are eligible for listing in the National Register of Historic Places. Any of these potential changes triggers the Section 106 review process which, in turn, provides the requisite information for the Memorandum of Agreement defining the disposition of such properties.

The review process was designed to ensure that historic properties are considered during federal project planning and execution.

PROCEDURES

The federal agency involved in the proposed project (EPA, in the case of this project) is responsible for initiating and completing the Section 106 review. The agency works with the State Historic Preservation Office and the Council to complete the process.

The process involves five steps:

1. Identify and evaluate historic properties listed or eligible for National Register listing which are located in the affected area.

2. Assess effects and make judgments regarding those effects. The findings will be one of the following:

   - o No effect: - No effect of any kind - agency can proceed with project
   - o No adverse effect: The project will affect historic properties but in a manner not harmful to them - agency can proceed with project
   - o Adverse effect: The project has the potential to negatively affect historic properties - consultation process begins.

3. Consultation: Potential avoidance or mitigation measures are explored to reduce harm to historic properties. Consulting parties are the agency and the SHPO (Council involvement is optional). The agency gathers needed documentation, informs the public that the process is underway, and works with consulting parties to find a solution. When an agreement on mitigation measures is reached, a Memorandum of Agreement (MOA) is signed. If the parties cannot agree, consultation is terminated and the agency must submit written documentation to the Council for their comments.

4. Council Comment: The agency submits the signed MOA to the Council for review. The Council can accept, request changes or issue written comments on the MOA. If the consultation process (Part 3) has been terminated, the Council issues written comments about the proposed agency action directly to the Agency Head. (Procedure takes up to 30 days with an MOA, or 60 days without.)

5. Proceed: If process has produced a Council-approved MOA, the project can proceed according to the MOA terms. Without an MOA, the Agency must take the Council's comments into account in the determination of how (or whether) to proceed with the project. (The agency must notify the Council of its decision.)

RELATED PERMITS AND ACTIVITIES

Federal permits which trigger the Section 106 review process are the EPA NPDES permit for wastewater discharges and the Army Corps of Engineers permit for activities within navigable waters.

PERMIT FACT SHEET

NAME OF PERMIT

Wetlands Order of Conditions

AGENCIES

Boston Conservation Commission, Quincy Conservation Commission, Winthrop Conservation Commission (may or may not be involved), Department of Environmental Quality Engineering (DEQE), Division of Wetland Protection

STATUTORY/REGULATORY AUTHORITY

M.G.L. Chapter 130, Section 105 and Chapter 131, Section 40 - Wetlands Protection Act
310 CMR 10.00, Wetlands Protection

APPLICABILITY

Any activity which will remove, fill, dredge, or alter an area as specified below or an activity within 100 ft of such an area which will alter the protected area. The following areas are subject to protection:

a)

any bank,	)	(the ocean
any freshwater wetland,	)	(an estuary
any coastal wetland,	)	(any creek
any beach,	) which	(any river
any dune,	) borders	(any stream
any flat,	) on	(any pond
any marsh,	)	(or any lake
any meadow,	)	
or any swamp	)	

b) Land under any of the water bodies listed above

c) Land subject to tidal action

d) Land subject to coastal storms flowage

e) Land subject to flooding

The MWRA's Secondary Treatment Facilities Plan project will likely involve removal, filling, dredging, and/or altering areas in, under, or within 100 feet of the area extending to the 100-year flood plain at Deer Island, Nut Island and possibly Winthrop (utilities). A more definitive discussion of regulated activities can be prepared following the completion of engineering studies.

The program protects the public interest by regulating projects to prevent damage to public or private water supplies, groundwater supplies, wildlife habitat, fisheries or shellfish areas and to prevent increases in flooding, storm damage and pollution.

PROCEDURES

Prior to filling, dredging, removing or altering any land subject to the Wetlands Protection Act, the applicant must receive an Order of Conditions from the conservation commission or the DEQE. The applicant must file a Notice of Intent with the conservation commission and the DEQE. Within 21 days, the conservation commission must hold a public hearing on the project. Within 21 days of the hearing, the commission must determine whether the area is significant to the interests of the Act and, if so, impose conditions on the project which will protect those interests. The permit is called an Order of Conditions.

If the conservation commission does not meet any deadline or if the applicant, any abutter, ten citizens of the town or any aggrieved person appeals within ten days of the commission's action, the DEQE will review the case and issue a Superseding Order of Conditions. Any party to the proceedings may request an adjudicatory hearing within ten days of the issuance of the Superseding Order of Conditions.

RELATED PERMITS AND ACTIVITIES

The applicant must have filed for all obtainable local permits, variances and approvals prior to filing the Notice of Intent. Prior to any action by the DEQE, the conservation commission must either have acted already or failed to act in a timely manner.

A Chapter 91 License from DEQE Division of Waterways will be required. A permit from the U.S. Army Corps of Engineers under 33 U.S. Code, Section 403 will also be necessary.

PERMIT FACT SHEET

NAME OF PERMIT

Hazardous Waste License

AGENCIES

Massachusetts Department of Environmental Quality Engineering (DEQE)

STATUTORY/REGULATORY AUTHORITY

M.G.L. Chapters 21C and 21E
310 CMR 30.00 - Hazardous Waste Regulations

APPLICABILITY

The hazardous waste regulations are intended to protect public health, safety, and welfare, and the environment, by comprehensively regulating the generation, storage, collection, transport, treatment, disposal, use, reuse, and recycling of hazardous waste in Massachusetts. Chapter 21E, entitled Oil and Hazardous Material Release Prevention and Response Act, addresses the need for assessing and responding to hazardous waste problems.

PROCEDURES

A license to transport, use, collect, store, treat, or dispose of hazardous waste must be obtained from DEQE pursuant to M.G.L. c.21C and 310 CMR 30.000. For land treatment demonstrations pursuant to 310 CMR 30.653, a description of plans includes: 1) the identification of hazardous wastes, 2) data sources or field tests to be used, 3) proposed land treatment, 4) dimensions of the treatment zone, and 5) a description of quantities and the destination of soils to be removed from the site, etc., as presented in 310 CMR 30.804. The requirements for obtaining and keeping a license also include provisions for maintaining compliance with standards and a determination of competence.

PERMIT FACT SHEET

NAME OF PERMIT

RCRA POTW Permit-by-Rule

AGENCIES

Mass. Department of Environmental Quality Engineering (DEQE), Divison of Water Pollution Control (DWPC)

STATUTORY/REGULATORY AUTHORITY

Federal	-	42 USC 6901 Resource Conservation and Recovery Act (RCRA) 40 CFR 270 - EPA Administered Permit Programs - The Hazardous Waste Permit Program
State	-	M.G.L. Chapter 21, Section 43 314 CMR 8.00 - Supplemental Requirements for Hazardous Waste Management Facilities

APPLICABILITY

314 CMR 8.00 - Supplemental Requirements for Hazardous Waste Management Facilities - establishes the program for wastewater treatment works. Included in this category are publicly-owned treatment works (POTWs) that generate, accumulate, treat, store, recycle, or dispose of hazardous waste. Pursuant to M.G.L. Chapter 21, Section 43, joint issuance of an NPDES Permit with EPA is consistent with RCRA Permit-by-Rule Provision (Section 270.60(c) for POTWs.) (Under M.G.L. Chapter 21C, Sections 4 and 6, and 310 CMR 30.600 and 30.801(4) publicly-owned wastewater treatment facilities which treat, store, or dispose of hazardous wastes generated at the same site are exempt from the Hazardous Waste License.)

PROCEDURES

Under the provision of Subpart F - Special Forms of Permits (Section 270.60 - Permits-by-Rule) a facility shall be considered to have the permit by rule if the owner/operator of a POTW which accepts for treatment hazardous waste:

(1) Has an NPDES permit;
(2) Complies with the conditions of that permit; and
(3) Complies with the following hazardous waste regulation

(i) Identification Number for Hazardous Waste Facilities (40 CFR 264.11);

(ii) Use of Hazardous Waste Manifest Systems for Offsite Transport (40 CFR 264.71);

(iii) Manifest Discrepancies Reporting (40 CFR 264.72);

(iv) Maintaining Operating Records (40 CFR 264.73(a) and (b)(1));

(v) Issue Biennial Report (40 CFR 264.75);

(vi) Prepares Unmanifested Waste Report (40 CFR 264.76); and

(vii) For NPDES permits issued after November 8, 1984 (40 CFR 264.101)

(4) If the waste meets all Federal, State, and local pretreatment requirements which would be applicable to the waste if it were being discharged into the POTW through a sewer pipe or similar conveyance.

RELATED PERMITS AND ACTIVITIES

NPDES Permit Program (Section 402 of the Clean Waters Act)

PERMIT FACT SHEET

NAME OF PERMIT

CZM Program/Federal Consistency Review

AGENCIES

Massachusetts Coastal Zone Management (CZM) Program - Executive Office of Environmental Affairs

STATUTORY/REGULATORY AUTHORITY

Federal - Coastal Zone Management Act, 16 U.S.C., Sections 1451-1464; 15 CFR Part 930, 40 CFR Section 122.49(d) and 33 CFR Section 320.4(h)

State - M.G.L. Chapter 6A, Sections 2-7 and M.G.L. Chapter 21A, Sections 1 - 15
301 CMR 20.00 - 22.00

APPLICABILITY

The issuance of federal permits for activities located within the coastal zone or affecting this zone, requires a certification that the activities are consistent with the state coastal zone policy. Deer Island is within the Massachusetts Coastal Zone and federal permitting actions include the NPDES permit from EPA and the Corps of Engineers permit for activities in navigable waters.

PROCEDURES

The applicant must review the coastal zone management policies, itemize the applicable policies, and evaluate the proposed project in terms of its consistency with the policies. The applicant's consistency determination is submitted to the Massachusetts CZM Office.

The CZM Office shall publish notice of the proposed activity in the Environmental Monitor, and shall review it in order to inform the federal agency of its concurrence or disagreement with the applicant's determination at the earliest possible time. This notice shall include a summary of the proposed activity and its location and a statement that the consistency determination and any accompanying information are available for public inspection and that public comments may be submitted to the CZM

Office within 21 days of the publication date. If a final response has not been issued within 45 days from receipt of the consistency determination, the CZM Office shall, at that time, inform the federal agency of the status of the matter and the basis for further delay. The CZM Office has a total of up to 6 months from the commencement of its review to issue its decision.

RELATED PERMITS AND ACTIVITIES

Under the Coastal Zone Management Act, before an applicant may receive a license or permit from a federal agency for activities affecting land or water uses in the coastal zone, the applicant must complete a consistency certification and the CZM Office must find that the activity is consistent with the CZM policies. Related federal permits are the EPA NPDES permit and the Corps of Engineers permit.

Prior to issuance of the CZM Office decision, the applicant must have received a certificate from the Secretary of the Massachusetts. Executive Office of Environmental Affairs on the Final Environmental Impact Report, if required.

PERMIT FACT SHEET

NAME OF PERMIT

National Pollutant Discharge Elimination System (NPDES) Permit

AGENCIES

U.S. Environmental Protection Agency (EPA)
Department of Environmental Quality Engineering, Division of Water Pollution Control (DWPC)

STATUTORY/REGULATORY AUTHORITY

Federal - Clean Water Act, 33 U.S.C., Sections 1257-1376 and especially Section 1342. EPA regulations are in 40 CFR 121, 122, 124, 124, 401.

State - Clean Water Act, M.G.L. Chapter 21, Section 43. DWPC regulations are in 314 CMR 1.00 to 7.00, and especially 3.00 for the discharge permit program.

APPLICABILITY

Any point source discharging pollutants into the waters of the United States requires a NPDES permit. This program protects and enhances water quality. The conditions of the permit establish quantity and quality limitations upon pollutants which may be discharged in order to maintain quality classifications assigned to the waters of the Commonwealth or the federal effluent standards assigned to a particular category of sources, whichever is the more stringent. The permit also establishes interim levels of pollutants which may be discharged from a point source where the treatment technology currently employed by such a source is unable to meet final limits established in the permit. In this case, the permit also establishes an implementation schedule for construction of the needed technology. All permits require the permittee to monitor the level pollutants in its discharge and report sample analyses to both the EPA and the DWPC in accordance with a schedule established in the permit.

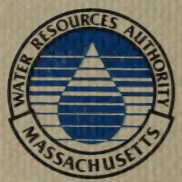
The MWRA was issued a final NPDES permit for its wastewater facilities on December 9, 1986.

PROCEDURES

The permit is issued jointly under federal and Massachusetts law. Under federal law this permit regulates the discharge of pollutants from any point source into waters of the United States. The Massachusetts statute similarly regulates point source discharges of pollutants into waters of the Commonwealth. By written agreement, the EPA and the DWPC jointly process and issue such permits for discharges in the Commonwealth. The procedure, which is directed by federal requirements, may take two years if parties exercise their rights to adjudicatory hearings. The applicant must file with both EPA and DWPC.

RELATED PERMITS AND ACTIVITIES

Directly-related permits are the Water Quality Certification from DWPC and the CZM concurrence with Consistency Certification. The construction of the outfall discharge will require a Wetlands Order of Conditions, a DEQE Chapter 91 Waterways License and a Corps of Engineers permit.


WATER RESOURCES AUTHORITY
MASSACHUSETTS